

Al-Ayen University
Petroleum Engineering College

Oil Properties
Second year

Dr. Najeh Yousef Alali

Lecture -2

Crude Oil and Gas Specifications

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1.1.3 Crude Oil Properties

Crude petroleum is very complex and, except for the low-boiling components, no attempt is made by the refiner to analyze for the pure components contained in the crude oil. Relatively simple analytical tests are run on the crude and the results of these are used with empirical correlations to evaluate the crude oils as feedstock for the particular refinery. Each crude is compared with the other feedstock available and, based upon the product realization, is assigned a value. The more useful properties are:

1.1.3.1 Gravity, °API

The density of petroleum oils is expressed in terms of API gravity rather than specific gravity; it is related to specific gravity in such a fashion that an increase in °API gravity corresponds to a decrease in specific gravity. The unit's °API gravity is API and can be calculated from specific gravity by the following: $^{\circ}\text{API} = 141.5 / \text{Sp.gr} - 131.5$

Both specific gravity and API gravity refer to the weight per unit volume at 60 °F. Crude oil gravity may range from less than 10 °API to over 50 ° but most crudes fall in the 20 ° to 45 °API range.

1.1.3.2 Sulfur Content

Sulfur content and API gravity are the two properties, which have the greatest influence on the value of crude oil. The sulfur content is expressed as percent sulfur by weight and varies from less than 0.1 % greater than 5 %. Crudes with sulfur greater than 0.5 % generally require more extensive processing than those with lower sulfur content. Although the term "sour" crude initially had reference to those crudes containing dissolved hydrogen sulfide independent of total sulfur content, it has come to mean any crude oil with sulfur content high enough to require special processing. There is no sharp dividing line between sour and sweet crudes, but 0.5% sulfur content is frequently used as the criterion.

1.1.3.3 Pour Point

The pour point of the crude oil, in °F, is a rough indicator of the relative paraffinicity and aromaticity of the crude. The lower the pour point the lower the paraffin content and the greater the content of aromatics.

1.1.3.4 Carbon Residue

Carbon residue is determined by distillation to a coke residue in the absence of air. The carbon residue is roughly related to the asphalt content of the crude and to the quantity of the lubricating oil fraction that can recover. In most cases the lower the carbon residue the more valuable the crude.

1.1.3.5 Salt Content

In the salt content of the crude, when expressed as NaCl, is greater than 10 lb/ 1,000 bbl, it is generally necessary to desalt the crude before processing. If the salt is not removed, severe corrosion problems may be encountered.

1.1.3.6 Nitrogen Content

High nitrogen content is undesirable in crude oils. Organic nitrogen compounds cause severe poisoning of catalysts used in processing. Crudes containing nitrogen in amounts above 0.25% by weight require special processing to remove the nitrogen.

1.1.3.7 Distillation Range

The boiling range of the crude gives an indication of the quantities of the various products present. The most useful type of distillation is known as a true boiling point (TBP) distillation and generally refers to a distillation performed in equipment that accomplishes a reasonable degree of fractionation. There is no specific test procedure used for TBP distillation, the U.S. Bureau of Mines Hempel and ASTM D-285 distillations are the tests most commonly used. Neither of these specifies either the number of theoretical plates or the reflux ratio used and, as a result, there is a trend toward using the results of a 15:5 distillation rather than the TBP. The 15:5 distillations are carried out using 15 theoretical plates at a reflux ratio of 5:1.

1.1.3.8 Metals Content

The metals content of crude oils can vary from a few parts per million to more than 1000 ppm and, in spite of their relatively low concentrations, are of considerable importance. Minute quantities of some of these metals (nickel, vanadium, and copper) can severely affect the activities of catalysts and result in a lower-value product distribution. Vanadium concentrations above 2 ppm in fuel oils can lead to severe corrosion to turbine blades and deterioration of refractory furnace linings and stacks.

1.1.4 Classification of Crude Oil

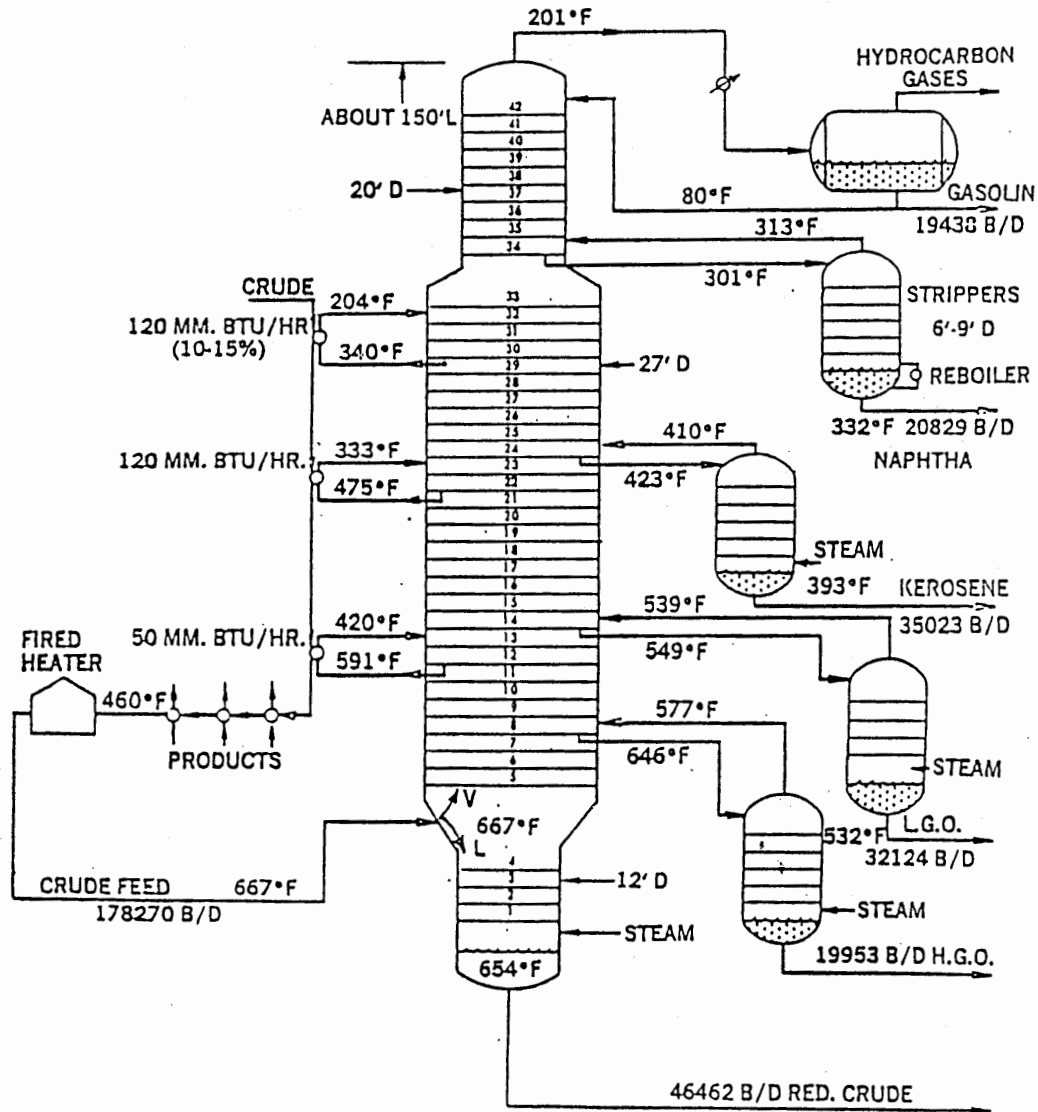
Crude oil is classified according to its composition as following:

- **Paraffin Base Crudes:** These crudes consist of more than 50% of paraffins.
- **Naphthene Base Crudes:** These crudes consist of more than 50% of Cyclic (Naphthenic) compounds.
- **Asphalt Base Crudes:** These crudes contain a very high percentage of aromatics.
- **Mixed Base Crudes:** These crude contain large quantities of both paraffinic and naphthenic compounds.

This does not mean, however, that the other groups of hydrocarbons are not represented in the oil and it may even be that, for instance, in the light fractions the aromatic predominate, while the normal paraffins are concentrated in the high boiling range. Apart

from hydrocarbons which can be grouped in one of the main classes paraffins, naphthenes cycloparaffins and aromatics. Crude oil may also contain mixed-type hydrocarbons, such as naphthenes with paraffinic side chains or aromatic nuclear with side chains, which cannot always be easily classified in either of the main groups, mentioned above. A rigid classification of crude paraffinic, naphthenic or mixed-type is, therefore, not possible.

1.1.5 Major Refinery Products



1.1.5.1 Liquefied Petroleum Gas (LPG)

LPG, which consists principally of propane and butane, is produced for use as fuel and is an intermediate material in the manufacture of petrochemicals. The important specifications for proper performance include vapor pressure and control of contaminants.

1.1.5.2 Gasoline

The most important refinery product is motor gasoline, a blend of hydrocarbons with boiling ranges from ambient temperatures to about 400 °F. The important qualities for gasoline are octane number (antiknock), volatility (starting and vapor lock), and vapor

pressure (environmental control). Additives are often used to enhance performance and provide protection against oxidation and rust formation.

1.1.5.3 Kerosene

Kerosene is a refined middle-distillate petroleum product that finds considerable use as a jet fuel and around the world in cooking and space heating. When used as a jet fuel, some of the critical qualities are freeze point, flash point, and smoke point. Commercial jet fuel has a boiling range of about 375°-525° F, and military jet fuel 130°-550° F. Kerosene, with less-critical specifications, is used for lighting, heating, solvents, and blending into diesel fuel.

1.1.5.4 Distillate Fuels

Diesel fuels and domestic heating oils have boiling ranges of about 400°- 700° F. The desirable qualities required for distillate fuels include controlled flash and pour points, clean burning, no deposit formation in storage tanks, and a proper diesel fuel cetane rating for good starting and combustion.

1.1.5.5 Residual Fuels

Many marine vessels, power plants, commercial buildings and industrial facilities use residual fuels or combinations of residual and distillate fuels for heating and processing. The two most critical specifications of residual fuels are viscosity and low sulfur content for environmental control.

1.1.5.6 Coke and Asphalt

Coke is almost pure carbon with a variety of uses from electrodes to charcoal briquettes. Asphalt, used for roads and roofing materials, must be inert to most chemicals and weather conditions.

1.1.5.7 Solvents

A variety of products, whose boiling points and hydrocarbon composition are closely controlled, are produced for use as solvents. These include benzene, toluene, and xylene.

1.1.5.8 Petrochemicals

Many products derived from crude oil refining, such as ethylene, propylene, butylene, and isobutylene, are primarily intended for use as petrochemical feedstock in the production of plastics, synthetic fibers, synthetic rubbers, and other products.

1.1.5.9 Lubricants

Special refining processes produce lubricating oil base stocks. Additives such as demulsifiers, antioxidants, and viscosity improvers are blended into the base stocks to provide the characteristics required for motor oils, industrial greases, lubricants, and cutting oils. The most critical quality for lubricating-oil base stock is a high viscosity index, which provides for greater consistency under varying temperatures.