# Petroleum Properties

## About the lecturer:

- Asst. lecturer Ahmed Razzaq Sahal is a Senior Petroleum Engineer in Iraqi Oil Ministry at the Field Division.

- M.S. from the University of Baghdad, and B.S. from University of Technology — all degrees in Petroleum Engineering.

- Work as Supervisor Drilling Engineer.

- Email: ahmedrazaq519@gmail.com and Ahmed.razzaq@alayen.edu.iq

## About the Course:

- 4 hr per week (1 hr Theoretical + 3 hr Practical)

- 2 Units.

## The syllabus:

1- Composition of reservoir fluid

2- Reservoir fluid properties

3- Reservoir fluid behavior

4- Laboratory analysis of reservoir fluids

5- Equation of state

6- Vapor-Liquid equilibrium calculations

# Lecture One: Composition of reservoir fluid

## 1.1 Crude oil

Petroleum (also called crude oil) is a naturally mixture of hydrocarbons, generally in the liquid state, that may also include compounds of sulfur, nitrogen, oxygen, and metals and other elements. Inorganic sediment and water may also be present. Thus, for the purposes of this text, a petroleum product is any product that is manufactured during petroleum refining and, as a consequence, petrochemical products are not included in this definition.

It consists of hydrocarbons of various molecular weights and other organic compounds. The name petroleum covers both naturally occurring unprocessed crude oil and products that are made up of refined crude oil. A fossil fuel, petroleum is formed when large quantities of dead organisms, usually zooplankton and algae, are buried underneath sedimentary rock and subjected to intense heat and pressure.

## 1.2 Theory or Source of Oil

- **Inorganic theory:** of the origin of the petroleum states that hydrogen and carbon came together under great temperature and pressure, far below the earth's surface and formed oil and gas. The oil and gas then seeped through porous rock to deposit in various natural underground traps.
- **Organic theory:** is the one most widely accepted. According to organic theory, the oil and gas are formed from remains of prehistoric plants and animals. Remains of plants have been transformed to coal and animals' to oil and gas. These remains were settled in to seas and lands along with sands and slits, mud and other minerals. As the rocks and slit settled, layer upon layer piled into rivers, along coastlines and on the sea bottom. Geological shifts resulted in some of these layers being buried deep in the earth.

Over the time, the layers of the organic material were compressed under the weight of the sediment above them. The increase in pressure and temperature changed the mud, sand, slit in to rock and organic matter in petroleum.

## 1.3 Composition and Classification of Crude Oils

Crude oil is a complex liquid mixture made up of a vast number of hydrocarbon compounds that consist mainly of carbon and hydrogen in differing proportions. In addition, small amounts of organic compounds containing sulfur, oxygen, nitrogen and metals such as vanadium, nickel, iron and copper are also present (See Table below).

| Element | Composition (wt%) |
|---|---|
| Carbon | 83.0–87.0 |
| Hydrogen | 10.0–14.0 |
| Sulphur | 0.05–6.0 |
| Nitrogen | 0.1–0.2 |
| Oxygen | 0.05–2.0 |
| Ni | <120 ppm |
| V | <1200 ppm |

There are three main classes of hydrocarbons. These are based on the type of carbon–carbon bonds present. These classes are:

- **Saturated hydrocarbons** contain only carbon–carbon single bonds. They are known as paraffin (or alkanes) if they are acyclic, or naphthenes (or cycloalkanes) if they are cyclic.
- **Unsaturated hydrocarbons** contain carbon–carbon multiple bonds (double, triple or both). These are unsaturated because they contain fewer hydrogen per carbon than paraffin. Unsaturated hydrocarbons are known as olefins. Those that contain a carbon–carbon double bond are called alkenes, while those with carbon–carbon triple bond are alkyenes.
- **Aromatic hydrocarbons** are special class of cyclic compounds related in structure to benzene.

# 1.4 Crude oil in Iraq

Iraq (defined as Federal Iraq and Kurdistan Regional Government) is the second-largest crude oil producer in the Organization of the Petroleum Exporting Countries (OPEC) after Saudi Arabia. It holds the world's fifth-largest proved crude oil reserves at 145 billion barrels, representing 17% of proved reserves in the Middle East and 8% of global reserves.[1] Most of Iraq's major known fields—all of which are located onshore—are producing or are in development.

Iraq's crude oil production grew by about 300,000 barrels per day (b/d) from 2013 through 2019, and it averaged 4.7 million b/d in 2019. During the first half of 2020, Iraqi crude oil output averaged about 4.4 million b/d. Iraq voluntarily reduced crude oil output in the second quarter of 2020 to comply with the OPEC+ Agreement. These production estimates include crude oil produced in the semi-autonomous northeast region in Iraq governed by the Kurdistan Regional Government (KRG).

Iraq's economy depends heavily on crude oil export revenues. In 2018, crude oil export revenue accounted for an estimated 91% of Iraq's total government revenues, according to the International Monetary Fund (IMF).

Iraq consumed 909,000 b/d of petroleum and other liquids in 2020. Liquids consumption in Iraq has grown by an average 4% per year during the past decade. Domestic refineries meet most of Iraq's petroleum consumption needs. However, Iraq relies on imports of some petroleum products, primarily gasoline. Iraq also uses crude oil for electric power generation.

A list of oil and gas fields in Iraq controlled by the Ministry of Oil in Baghdad : Ahdab Oil Field, Akkas Gas Field, Badra Oil Field, Bai Hassan Oil Field, Block 1 to Block 12, Eastern Fields, East Baghdad Oil Field, Garraf Oil Field, Halfaya Oil Field, Kirkuk Oil Field, Majnoon Oil Field, Mansuriyah Gas Field, Maysan Oil Fields, Middle Furat Oil Fields, Nahr Bin Umar Oil Field, Najmah Oil Field, Nasiriyah Oil Field, Qayara Oil Field, Rumaila Oil Field, Siba Gas Field, West Qurna 1 Oil Field, West Qurna 2 Oil Field, Zubair Oil Field.


40°
42°
44°
46°
48°
36°
34°
32°
30°
N
TURKEY
SYRIA
IRAN
IRAQ
SAUDI ARABIA
KUWAIT
Arabian Gulf
Euphrates/Mardin
Palmyra Zone
Khleisya Uplift
Wadi-Surhan Basin
Widyan Basin
Rutbah Uplift
Hail-Ga'Ara Arch
Widian Basin-Interior Platform
Zagros Thrust Zone
Zagros Fold Belt
Mesopotamian Foredeep Basin
Duhok
Mosul
Erbil
Sulaimaniya
Kirkuk
Tikrit
Qaem
Anah Graben
Haditha
Ramadi
Rutbah
Baghdad
East Baghdad
Kerbala
Hilla
Kut
Najaf
Diwaniya
Emara
Samawa
Nasiriyah
Qurna
Basrah
Zubair
LEGEND
Basin Boundary
River
Lakes and Marshes
City
Oil Field
Gas Field
0 40 80 120 Km.