— University of Mosul —
College of Petroleum & Mining Engineering

Analytical Chemistry

Lecture …(3)….

Petroleum and Refining Engineering Department

Lec -2- Analytical Chemistry Applications in Petroleum Engineering:
Quantitative and Qualitative Techniques with Practical Calculations

Part 1: Quantitative Analytical Chemistry

1. API Gravity

As mentioned in the first lecture, **API gravity** is a measure of how heavy or light crude oil is. The formula used for calculating API gravity is:

Formula:

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

Example Question 1:

Crude oil specific gravity = **0.82**.

✅ **Sulfur content = 60 ppm**

✅ Interpretation: Too high if limit is 15 ppm (must be reduced).

Example Question 4:

Gasoline contains **150 ppm** sulfur.
Convert to % weight.

Solution:

$$\text{Weight \%} = \frac{\text{ppm}}{10,000}$$

$$\text{Weight \%} = \frac{150}{10,000} = 0.015\%$$

✅ **Sulfur content = 0.015%**

✅ Interpretation: Acceptable for regular gasoline (limit varies by country).

Common ASTM Tests for Petroleum Products:

These are **important tests** used to measure the quality of petroleum products:

1. **D86 – Distillation Curve (Boiling Points):**
   - This test checks the **boiling points** of different parts of the petroleum product. It helps determine the best way to separate the **gasoline**, **diesel**, and other products during refining.

   Numerical Example:

   - If gasoline boils at temperatures between **40°C to 200°C**, this helps the refinery know at what temperature to separate it from other products.
2. **D445 – Kinematic Viscosity:**
   - This measures how **thick** or **thin** the product is. If it's too thick, it won't flow well, and if it's too thin, it won't lubricate the engine properly.

   Numerical Example:

   - A **diesel fuel** might have a **viscosity of 2.5 cSt (centistokes)**. This tells us how thick or thin it is. For reference, **thicker** oils have a viscosity higher than **3.0 cSt**, and **thinner oils** have a viscosity **lower than 1.0 cSt**.
3. **D4294 – Sulfur by XRF (X-Ray Fluorescence):**
   - This test measures how much **sulfur** is in the product. Too much sulfur in fuel is bad for the environment.

Part 2: Qualitative Analytical Chemistry

1. Gas Chromatography (GC)

✅ GC tells us **which hydrocarbons** are present.

GC is used to **identify** what hydrocarbons are present in fuels without giving exact amounts.

Example:
A GC analysis shows the following in gasoline:

- **Heptane:** Detected
- **Octane:** Detected
- **Benzene:** Detected
- **Ethanol:** Detected

Example Question:

GC shows:

- Hexane = 40%
- Benzene = 6%

Regulation says benzene must be < 1%.

Is the sample acceptable?