

Republic of Iraq
Ministry of Higher Education
and Scientific Research
Al-Mustaqbal University College
Chemical Engineering and Petroleum Industries Department



Subject: Properties of Petroleum Fuels

3rd Class

Lecture six

WAXES

- The chemical composition of waxes is complex, but normal alkanes are always present in high proportions, and molecular weight profiles tend to be wide.
- The main commercial source of wax is crude oil, but not all crude oils when processed produce wax.
- Wax is also produced from lignite, plants, and animals.
- Even insects produce a material sold commercially as wax.

PARAFFIN WAXES

- The three general categories of petroleum waxes obtained from lube oil refining are
 - paraffin,
 - microcrystalline waxes,
 - and petrolatum.
- Paraffin waxes are derived from light lubricating oil distillate processing.
- Paraffin waxes contain predominantly straight chain hydrocarbons with an average chain length of 20 to 30 carbon atoms.
- Paraffin waxes are characterized by a clearly defined crystal structure and have the tendency to be hard and brittle.
- The melting point of paraffin wax falls between 120 and 160°F.
- Wax properties are determined by molecular weight, chemical composition, and oil content.
- Paraffin waxes have the following general properties:
 - Nonreactive
 - Nontoxic
 - Good water barrier
 - Clean burning fuel
 - Colorless

The properties of wax that can be measured and controlled are as follows:

- Melting point
 - Hardness
 - Oil content
 - Viscosity
 - Color
 - Odor and taste
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- However, these physical properties alone do not completely define the suitability of wax for a particular application.
 - The important functional properties of wax are translucency or opaqueness, solid appearance (dry, waxy, mottled, or shiny), and flexibility.

- It is the combination of physical and functional properties that ultimately determines whether a particular wax is suitable for a given application.
- Fully refined paraffin waxes are hard, brittle, white, and odorless materials with less than 0.5 percent oil.
- They have good gloss properties and a melting point between 115 and 155°F.
- It is a softer material with a color varying between white and yellow.

PROPERTIES

- The properties of petroleum wax depend on its hydrocarbon composition and degree of refining.
- Some important properties of petroleum waxes are described next (Table 16-7).

TABLE 16-7 Typical Properties of Paraffin Waxes

| Property | | Paraffin wax |
|-----------------------|--------------|--------------|
| Average mol wt | | 350–420 |
| Carbon atoms/molecule | | 20–36 |
| Flash point | COC, °F | 399.2 |
| Melting point | °F | 115–155 |
| Needle penetration | 77°F | 11–15 |
| Oil content | Wt % | 0.5 |
| Refractive index | 210°F | 1.43–1.433 |
| Viscosity | cSt, @ 210°F | 4.2–7.4 |

- **Melting Point**

- The melting point is the temperature at which wax liquefies when heated or reverts back to a solid state when cooled. Paraffin waxes have a sharp melting point.

- **Oil Content**

- The oil content of paraffin wax is reduced during the refining process. All petroleum waxes contain oil.

- Oil in paraffin wax adversely affects the gloss, hardness, strength, and color.

- **Taste, Odor, and Color**

- Taste, odor, and color depend on the degree of refining. Food-grade petroleum waxes are white with little or no odor or taste. The color of highly refined paraffin wax is reported as the Saybolt color.

TEST METHODS

- **Melting Point**

- Selection of a proper melting point method depends on the characteristics of the wax. Open or closed capillary tubes are used to measure the melting point of many natural waxes.

- Oil Content
 - The production of petroleum wax involves the removal of oil. The oil content of wax is thus an indication of the quality of the wax.
- Viscosity
 - Viscosity is an important test for mineral and synthetic waxes. ASTM D 88 is used to measure the time in seconds required for a specified quantity of wax at a specified temperature to flow by gravity through an orifice of specified dimensions. This viscosity is expressed in Saybolt Universal Seconds (SUS).
- Acid Number
 - Acid number (ASTM D 1386) is the milligrams of potassium hydroxide necessary to neutralize 1 g of wax. It indicates the free carboxylic acid present. The test is widely used for vegetable, insect wax, and synthetic waxes containing carboxylic acid groups.
- Saponification Number
 - The saponification number (ASTM D 1387) is the milligrams of potassium hydroxide that react with 1 g of wax at an elevated temperature and indicates the amount of free carboxylic acid plus any ester materials that may be saponified. Both acid number and saponification number are generally provided to give an indication of the free carboxylic acid and ester content of vegetable and insect waxes and synthetic waxes containing carboxylic acids and/or esters.

Wax Applications

- Waxes are used as a feedstock for many products and for a wide range of applications: – candle making,
 - **coatings**
 - foods
 - cosmetics
 - **adhesives**
 - inks
 - casting
 - crayons
 - **polishes**
 - chewing gums.