**Introduction to Petroleum Refinery**

**What is Crude Oil?**

* Crude oil is a mixture of hydrocarbons formed from organic matter.
* Crude varies in color and composition
* Composition varies
  + Sulfur content
  + Density varies
  + Contains sediment and water

**Products from Petroleum**

The ten main products of petroleum are:

* **Asphalt**

Asphalt is commonly used to make roads. It is a colloid of asphaltenes and maltenes that is separated from the other components of crude oil by fractional distillation. Once asphalt is collected, it is processed in a de-asphalting unit, and then goes through a process called “blowing” where it is reacted with oxygen to make it harden.

* **Diesel**

Diesel is any fuel that can be used in a diesel engine. Diesel is produced by fractional distillation between 392° - 662° F. Diesel has a higher density than gasoline and is simpler to refine from crude oil. It is most commonly used in transportation.

* **Fuel Oil**

Fuel oil is any liquid petroleum product that is burned in a furnace to generate heat. Fuel oil is also the heaviest commercial fuel that is produced from crude oil.

* **Gasoline**

It is mainly used as fuel in internal combustion engines, like the engines in cars. Gasoline is a mixture of paraffins, naphthenes, and olefins.

Gasoline refined beyond fractional distillation is often enhanced with iso-octane and ethanol so that it is usable in cars.

* **Kerosene**

Kerosene is collected through fractional distillation at temperatures between 302° - 527° F. It is a combustible liquid that is thin and clear. Kerosene is most commonly used as jet fuel and as heating fuel.

* **Liquefied Petroleum Gas (LPG)**

LPG is a mixture of gases that are most often used in heating appliances, aerosol propellants, and refrigerants. Different kinds of LPG are propane and butane. At normal atmospheric pressure, LPG will evaporate, so it needs to be contained in pressurized steel bottles.

* **Lubricating Oil**

Lubricating oils consist of base oils and additives. Mineral oils are manufactured by special processes called: solvent extraction, catalytic dewaxing, hydrocracking, and isohydromerization. Lubricating oils are used between two surfaces to reduce friction and wear. The most commonly-known lubricating oil is motor oil, which protects moving parts inside an internal combustion engine.

* **Paraffin Wax**

Paraffin wax is a white, odorless, tasteless, waxy solid at room temperature. The melting point of paraffin wax is between 117° - 147° F. It is an excellent electrical insulator, second only to Teflon®, a specialized product of petroleum. Paraffin wax is used in drywall to insulate buildings. It is also an acceptable wax used to make candles.

* **Bitumen**

Bitumen, commonly known as tar, is a thick, black, sticky material. Refined bitumen is the bottom fraction obtained by the fractional distillation of crude oil. This means that the boiling point of bitumen is very high, so it does not rise in the distillation chamber. The boiling point of bitumen is 977° Fahrenheit. Bitumen is used in paving roads and waterproofing roofs and boats.

* **Petrochemicals**

Petrochemicals are the chemical products made from the raw materials of petroleum. These chemicals include: **ethylene**, used to make anesthetics, antifreeze, and detergents; **propylene**, used to produce acetone and phenol; **benzene**, used to make other chemicals and explosives; **toluene**, used as a solvent and in refined gasoline; and **xylene** is used as a solvent and cleaning agent.

**History and Development of Refining Processes**

►In 1816, natural gas captured from a coal coking plant was first used in America to fuel street lamps in Baltimore, Maryland.

►In 1847, the process to distill [kerosene](https://en.wikipedia.org/wiki/Kerosene) from petroleum was invented by [James Young](https://en.wikipedia.org/wiki/James_Young_(Scottish_chemist)). He noticed a natural petroleum seepage, from which he distilled a light thin oil suitable for use as lamp oil, at the same time obtaining a thicker oil suitable for lubricating machinery.

►In 1848 Young set up a small business refining the crude oil.

►Young eventually succeeded, by distilling [cannel coal](https://en.wikipedia.org/wiki/Cannel_coal) at a low heat. Young found that by slow distillation he could obtain a number of useful liquids from it, one of which he named "paraffine oil" because at low temperatures it congealed into a substance resembling paraffin wax.

►1851 Young & Meldrum and Edward William Binney : the first truly commercial oil-works in the world with the first modern oil refinery, using oil extracted from locally mined [torbanite](https://en.wikipedia.org/wiki/Torbanite" \o "Torbanite), shale, and bituminous coal to manufacture [naphtha](https://en.wikipedia.org/wiki/Naphtha) and lubricating oils.

►Another early refinery was built by [Ignacy Łukasiewicz](https://en.wikipedia.org/wiki/Ignacy_%C5%81ukasiewicz" \o "Ignacy Łukasiewicz), providing a cheaper alternative to [whale oil](https://en.wikipedia.org/wiki/Whale_oil).

►[Edwin Drake](https://en.wikipedia.org/wiki/Edwin_Drake)'s [1859 well](https://en.wikipedia.org/wiki/Drake_Well) near Pennsylvania, is popularly considered the first modern well. Drake's well is probably singled out because it was drilled, not dug; because it used a steam engine

►A group directed by Major Alexeyev of the Bakinskii Corps of Mining Engineers hand-drilled a well in the Baku region in 1848.

►There were engine-drilled wells in West Virginia in the same year as Drake's well.

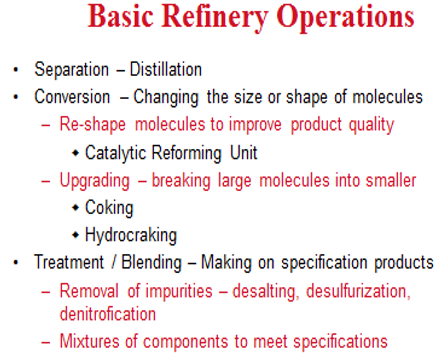
►An early commercial well was hand dug in [Poland](https://en.wikipedia.org/wiki/Poland) in 1853, and another in nearby [Romania](https://en.wikipedia.org/wiki/Romania) in 1857. At around the same time the world's first, small, oil refinery was opened at [Jasło](https://en.wikipedia.org/wiki/Jas%C5%82o" \o "Jasło) in Poland, with a larger one opened at [Ploiești](https://en.wikipedia.org/wiki/Ploie%C8%99ti" \o "Ploiești) in Romania shortly after.

►Romania is the first country in the world to have had its annual crude oil output officially recorded in international statistics: 275 tons for 1857.

►The [first commercial oil well](https://en.wikipedia.org/wiki/History_of_the_petroleum_industry_in_Canada#Early_origins) in Canada became operational in 1858 at [Oil Springs, Ontario](https://en.wikipedia.org/wiki/Oil_Springs,_Ontario).

►Businessman [James Miller Williams](https://en.wikipedia.org/wiki/James_Miller_Williams) dug several wells between 1855 and 1858 before discovering a rich reserve of oil four metres below ground.[[23]](https://en.wikipedia.org/wiki/Petroleum#cite_note-23) Williams extracted 1.5 million litres of crude oil by 1860, refining much of it into kerosene lamp oil.

► Advances in drilling continued into 1862 when local driller Shaw reached a depth of 62 metres using the spring-pole drilling method.



**Kinds of Refineries**

1. **According to size:**

►Small refinery: 2000 - 10000 tons of crude oil/ day.

►Large refinery: 20000 - 40000tons/day.

►These are a few refineries up to 60000tons/day.

1. **According to complexity:**

Refineries vary in complexity;i.e. in the variety of processes operated and of productsthat are sent out.

►Simple refinery: may make only **gasoline, diesel fuel**, and **heavy fuel**.

Simple refinery consist of:

1. Crude oil distilling unit 2- Gasoline sweetening unit
2. Catalytic reformer*.*

The crude oil is distilled into:

1-**Gaseous hydrocarbons**, which are burnt as refinery fuel.

2- **Light gasoline**, which will need **sweetening**

3-**Naphtha of very low octane number**, perhaps 40 compared with a market of 90. It is **catalytically reformed**, by which **octane number of 90 to 95** can be obtained.

**Next stage of complexity** is to added a ***desulphurization*** unit to treat the diesel fuel.

Usually also the **growing refinery** will make **(LPG)** and some **low grade kerosene**. The **kerosene** will also need refining, at least ***sweetening*** to make it of **marketable odor.**

►Large Complex Refinery: will have many more units:

**a) Vacuum Distillation**: To make a heavy distillate suitable for catalytic cracking or hydro-cracking or manufacture of lubricating oils , and a residue which may be blown or further distilled for bitumen.

**b) Hydro-cracking**: which makes more naphtha for catalytic reforming, more diesel fuel and low sulfur fuel.

**c) Catalytic Cracking**: which makes much gas, suitable for LPG and high grade gasoline.

**d) Wax Plant**: de-waxing to get wax out of oil, then de oiling of the crude wax and final purification the wax by hydrogenation.

**e) Sweetening and Desulphurization**: for jet fuel.

**f) Alkylation unit** : to synthesize very high octane gasoline.

**g) Lubricating oil refining**: special plant to remove resinous and solidifying materials from lubricating oil stocks and achieve the finished product by blending.