

Crude Oil

The world consumes 1.5 billion gallons of petroleum every day, whether as fuel, petrochemicals, lubricants, or uncounted other uses. This enormous demand makes crude oil the single most important raw material to our civilization.

When it emerges from the ground, crude oil is a mixture of thousands of hydrocarbons in solid, liquid, and gaseous form. This mixture is practically useless until it is refined into fuels, lubricants, petrochemicals, asphalts, solvents, plastics, waxes, and a large number of other materials. Petroleum-based fuels alone account for more than half the world's total supply of energy (and on the down side, account for much of the pollution in industrialized countries).

Crude oil comes from concentrations of aquatic plants and animals that died hundreds of millions of years ago, buried under mud and sand in layered deposits that slowly decayed. Through heat and pressure over the millennia, these concentrations were geologically transformed into petroleum. Because new petroleum requires a geological age to be created, it is obviously not being replenished as fast as we are using it. Much of the work in the petroleum industry is involved in estimating the world's reserves of crude oil.

The components of crude oil can be categorized by molecular size. Small molecules (containing 1-4 carbon atoms) are usually gases; larger molecules (four to about ten carbon atoms) are used as gasoline; hydrocarbons with about 50 carbon atoms are the source of light fuels and lubricating oils, while giant molecules of up to several hundred carbon atoms are the waxes, asphalts, and heavy fuels. With the extreme pressures underground, both gases and heavy wax are dissolved into the liquid crude, but on reaching the surface these components separate out.

Though they are all made up primarily of hydrocarbons with small traces of sulfur, oxygen, and nitrogen, crude oils vary a great deal in their actual compositions and material properties. Black tarry asphalts are found in Trinidad and the Athabasca tar sands of Canada. Light, volatile oils which can be used directly as gasoline, are found in the Kettleman hills of California. Some crude oil smells like turpentine or camphor; other crude smells light and pleasant, while still others have a sulfur smell. Crude oil can be black, dark brown, reddish brown, cherry red, amber, green, or yellow; some fluoresce green or purple in reflected light. Physical properties such as specific gravity, volatility, and viscosity

also vary according to the hydrocarbon mixture.

Crude oil pooling up from natural seeps in the ground has been used for more than 6,000 years, as evidenced by Mesopotamian inscriptions (dated at 4000 B.C.) that describe uses for asphalt and oil, such as setting jewels and mosaic tiles or fastening the blades of implements and weapons to their handles. In Egypt, crude oil was used as a wound dressing, a liniment, and a laxative, as well as for embalming mummies.

People settling around the Black and Caspian Seas used oil skimmed from natural pools for cooking, lubrication, heating, paving roads, cementing bricks, and caulking seams in their boats. By the third century B.C., the Chinese had accidentally encountered oil while drilling for salt. Shortly thereafter, they began drilling for oil itself, using percussion bits, bamboo pipes, and manpower; when nineteenth-century Christian missionaries returned from China with descriptions of these oil-drilling systems, the ancient concepts greatly influenced industrial oil drilling worldwide. The word "petroleum" itself was not used until 1556, in a treatise published by the mineralogist Georg Bauer (Georgius Agricola) in Germany. The word derives from the Latin for "rock" and "oil".

Fifteenth century Spanish explorers first discovered oil seeps in Cuba, Bolivia, Mexico, and Peru. Explorers sent a barrel of oil from Lake Maracaibo, Venezuela, to the king of Spain in 1539. Pirates from the region frequently used the crude pitch to caulk their raiding ships. In 1542, the Spanish sailor Juan Rodriguez wrote about finding oil near Santa Barbara, California. A year later, survivors of the de Soto expedition that had gone in search of the Fountain of Youth used oil residues from the area of what is now Nacogdoches, Texas, to repair their boats.

In 1854 the first kerosene lamp was invented, offering a useful alternative to whale oil used for illumination. Intense searches had been made to find a substitute light source because whale oil had become very expensive. On December 30, 1854, the first American oil company, the Pennsylvania Rock Oil Company, was formed in New Haven, Connecticut, to commercialize the production of petroleum.

In North America, the Indians used crude oil for medicinal purposes and had known of plentiful oil seeps in what is now Pennsylvania and New York. On August 27, 1859, Colonel Edwin E. Drake drilled the first successful U.S. commercial oil well

on Watson's Flat beside Oil Creek near Titusville, Pennsylvania, striking oil at a depth of 21.2 m. Drake's successful well initiated the Pennsylvania oil boom. The areas surrounding Titusville were immediately leased, and extensive exploratory drilling took place.

Oil was first exported to London in wooden barrels in 1861. By 1875, oil wells had been drilled throughout the United States, reaching California and even spreading to offshore drilling from wharves near Santa Barbara by 1890. The U.S. output of crude oil leaped from 2000 barrels in 1859 to three million barrels in 1863 to about ten million in 1874.

Alfred Nobel (inventor of dynamite) and his brother Ludwig invested a great deal of their fortune to develop the Baku oil fields near the Caspian Sea in Russia. In 1877 Ludwig Nobel commissioned an iron steamer, *Zoroaster*, to be constructed at the Swedish shipyards and used to haul barrels of oil between Baku and the Volga River; *Zoroaster* was the first of a fleet of such oil tankers. By the beginning of the twentieth century, the United States and Russia combined accounted for 90% of the world's oil production.

In 1901 the wealthy Englishman William Knox D'Arcy (who had made his fortune in Australian gold mines) studied the work of an archaeologist in France, Jacques de Morgan, who suggested that a great deal of crude oil could be found in Persia and the Middle East. D'Arcy began negotiations with the Persian government and later the Turkish government. He received financial support from the British government, and the venture was a limited success. World War I and later the popularity of the automobile highlighted the great importance of petroleum, and more vigorous efforts were concentrated in the Middle East. In 1933 Standard Oil of California secured oil rights in Saudi Arabia, and struck a large reserve in 1935—leading to the immense Middle Eastern oil boom. By the 1970s, the Middle East was providing over 38% of the world's supply, though a decade later the influence of the Organization of the Petroleum Exporting Countries (OPEC) and wars in the region had reduced this worldwide percentage to about 28%.

In the next Historical Note, we will look at the history of refining petroleum and deriving other useful materials from crude oil.

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