What Is Petroleum?

Petroleum is the source of most of the fuels used today — gasoline, diesel fuel, and kerosene, for example. It is found as an oily liquid mixture deep beneath Earth's surface. In Alberta, petroleum was first discovered in 1904, but the "big one" — an oil well at Leduc — did not blow sky-high until 1947 (see Figure 1).

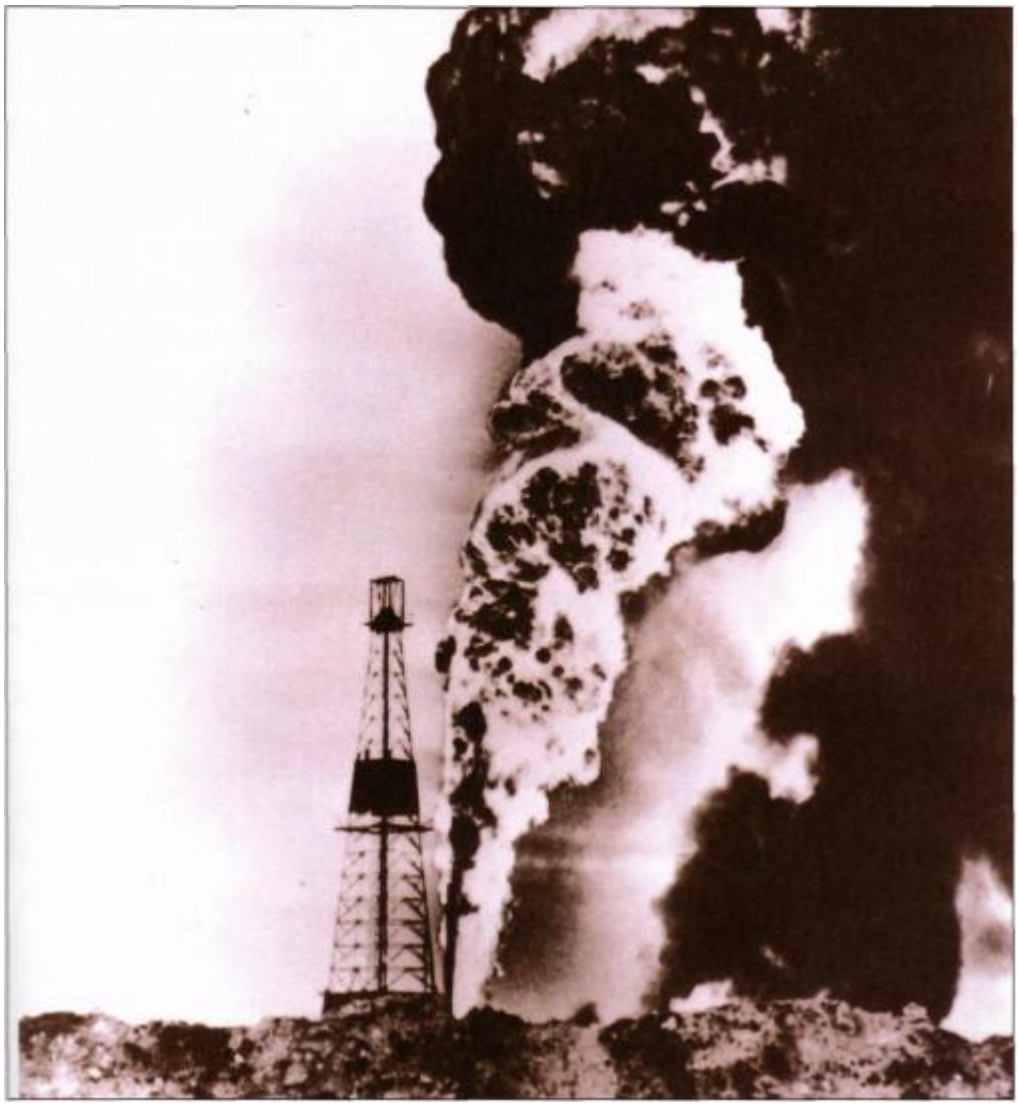

Figure 1. This picture of the Leduc gusher was published in all the major Canadian newspapers and shown in newsreels in movie theatres across the country. Everyone was excited because, at last, Canada would probably be able to supply all of its own petroleum needs.

Extracting Petroleum from Underground

Thousands of years ago, people in the Middle East noticed an oily black liquid bubbling up through the sand. They recognized that it could be burned, but the flame was smoky and not very bright. They used it only when they had none of their usual lamp fuel. Lamps from the past used fuel that was made from vegetable or animal oils, as shown in Figures 2 and 3.

Figure 2. In the Middle East, oil lamps burned plant-based fuels, such as olive oil.

Figure 3. In the Arctic, stone lamps burned animal fat.

Even 150 years ago, there was little interest in petroleum. The Europeans who settled in North America used other fuels: coal to run steam engines, wood for home heat, and whale oil for light. By 1850 whale oil was becoming scarce. Its price rose dramatically, and people began to search for alternative lighting fuels.

In Nova Scotia, a researcher named Abraham Gesner (1797-1864), shown in Figure 4, began to experiment with natural tar found in surface deposits. This solid form of petroleum did not look much like a lighting fuel at the beginning. It did look like a mixture, however. By 1853 Gesner had perfected a process to separate the tar mixture. This process produced a new liquid fuel, which was ideal for lighting. It was easy to pour; it burned with a clear, steady, bright yellow flame, and the flame was nearly smoke-free. Gesner named the new fuel kerosene. Kerosene would not burn in lamps designed to burn whale oil, so Gesner also invented a new kind of lamp to burn it (see Figure 5). Today we think of kerosene lamps as old-fashioned, but they are still the main source of lighting in many parts of the world.

Figure 4. Dr. Abraham Gesner patented many inventions, but none was more important than the technology for kerosene lighting.

Figure 5. The kerosene lamp represented an important technological advance. As one tribute stated, Gesner truly did "give the world a better light."

Suddenly, underground petroleum was seen as a valuable natural resource, and active exploration began in North America. Petroleum was discovered near Sarnia, Ontario, in 1857. It served an important purpose as a fuel for lighting, but once cars became common, there was a great demand for fuel made from petroleum. Alberta oil wells have satisfied this demand in Canada. More recently, large reserves of petroleum have been discovered offshore near Newfoundland (see Figure 6).

Figure 6. In the Hibernia oil field, large oil rigs are used to extract petroleum from beneath the ocean floor.

Because our modern world runs on the energy of petroleum, oil exploration companies now spend millions of dollars drilling test holes to locate new underground deposits of petroleum. Petroleum products, such as kerosene, gasoline, and diesel oil, are burned to produce electricity, move vehicles of all kinds, and do many other kinds of work.

Like water wells, oil wells use pumps to bring the underground liquid up to the surface. Pumping petroleum is not as easy as pumping water because the oil is a very thick liquid. It is found in small, sponge-like pores of underground rock. The diagram below shows how petroleum is brought up to the surface.

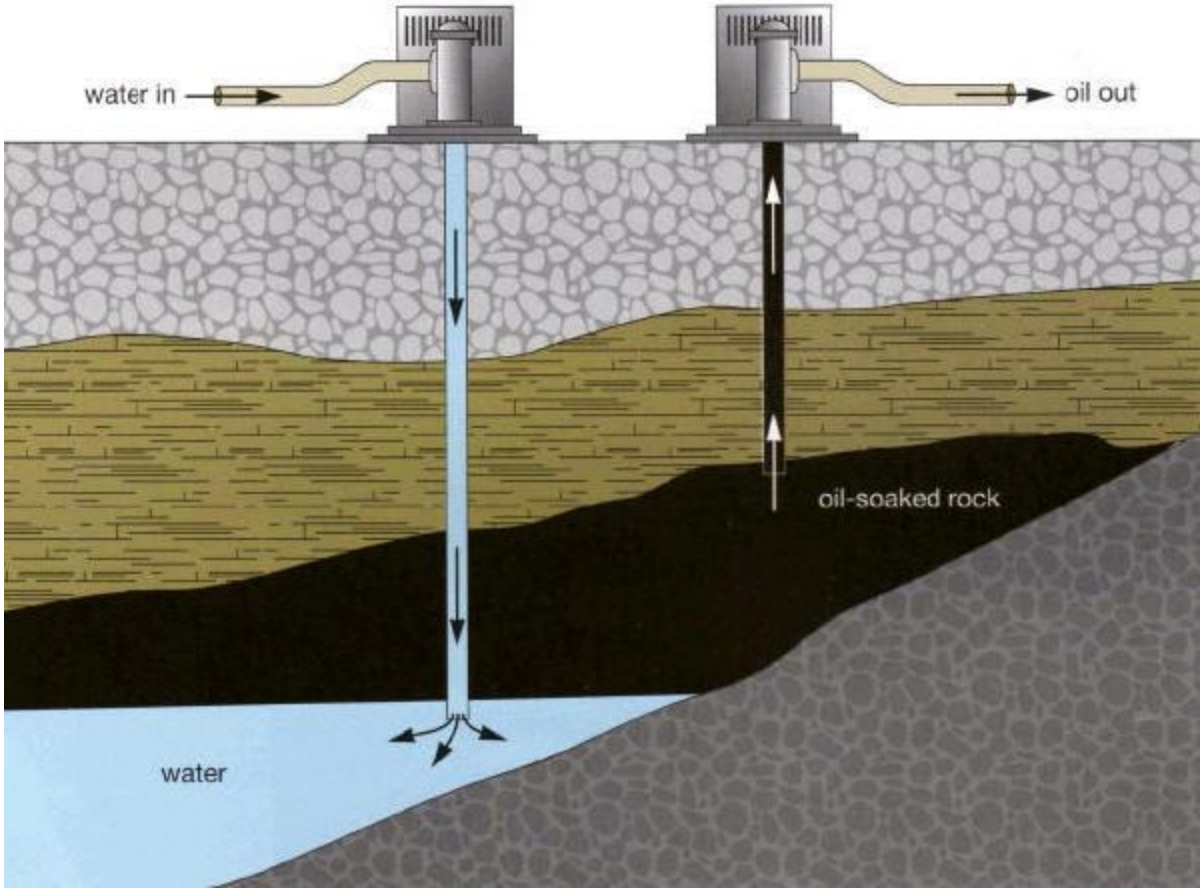

Figure 7. Due to its insolubility in water, petroleum may be pushed by pumping water in below it.

Processing Petroleum

Pumping petroleum to the surface is only the first step. What comes out of the pump is crude petroleum, a raw material. As you can see in Figure 1, burning crude petroleum produces a lot of black smoke. To make usable products, petroleum must be processed. The factories that process petroleum are called oil refineries. Refining is the processing of petroleum to separate it into its parts.

In 1857 the refineries in Ontario made just two petroleum products. One was buggy wheel grease, which is thick and gooey; the other was kerosene lamp fuel, which is thin and runny. Why are their properties so different? The main reason is particle size. When petroleum comes straight from the ground, the particles vary in size. Some are nearly as small as water particles; others are bigger than sugar particles. The mixture of particles is not very useful in its natural state. Before petroleum can be used in a vehicle, for example, it must be processed to make specialized fuels, such as kerosene, gasoline, and diesel fuel.

Fractional Distillation

The process that yields all of these different petroleum products is known as **fractional distillation.** Fractional distillation is done in a two-tower structure, as shown in Figure 8. In the shorter tower, the petroleum is heated strongly enough to vaporize every part of the mixture. Then the mixture of hot vapours is pumped into the bottom of the taller tower.

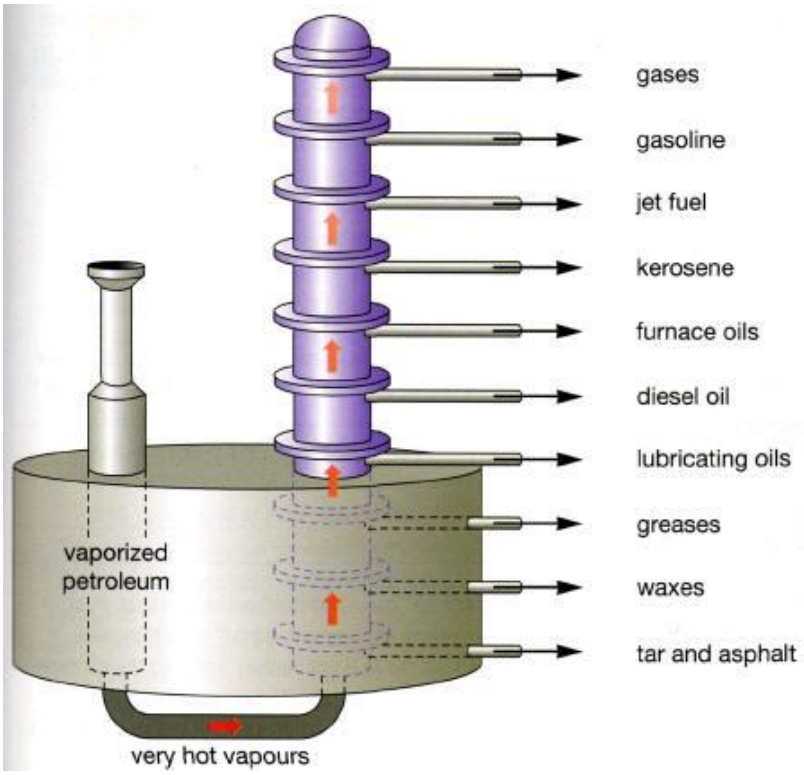

Figure 8. Fractionating towers are a common sight in the oil-producing regions of Canada. What raw materials enter the short tower? What change takes place there? What processed materials leave the tall tower?

Inside the tall tower, the hot vapours rise. As they rise, they cool. Remember that these are different pure substances, so they have different properties. This means that some of them condense and form a liquid while they are still very hot, near the bottom of the tower. As the remaining vapours continue to rise, different ones condense at different levels in the tower. Near the top (the coolest part) of the tower, a few remain as a gas.

Each fraction is drawn off by the collecting pipes at its own level and is sent to a different part of the refinery for further processing. There each material may be converted into petrochemicals. **Petrochemicals** are entirely new products made from the same raw material — petroleum. Scientists have developed and produced over 500 000 different petrochemicals.