

Understanding Sudan

A Teaching and Learning Resource



Fact Sheet One: Chemistry and Production

What is oil?

Oil is the colloquial name for petroleum, the most important energy source in the world today. In the United States, 90% of vehicles are powered by oil, and 40% of all energy consumption comes from the burning of petroleum. Oil is used in a similar way throughout the world. It is also used in many of the chemicals that make up some of the world's most important commodities and products. For example, did you know that many plastics are made with petroleum?

Oil is central to our lives. Yet despite this centrality, many people know surprisingly little about its production. What do you know?

When we talk about oil in the economy, we're not talking about olive oil or vegetable oil. Rather, we are referring to petroleum, or crude oil. Crude oil occurs naturally. It is a flammable liquid that builds up under the earth over time. While it is almost entirely constituted by hydrocarbons of various weights, there are also many other organic compounds and trace elements in different types of oil. The exact composition of the crude oil has implications, as we shall see, for its production and sale.

How is oil made?

Crude oil forms incredibly slowly. The oil we use today comes from the remains of prehistoric algae, which sank to the bottom of seas and lakes eons ago. Over long periods of time, these remains were buried under many layers of heavy sediment. The pressure and heat caused by this process made the organic matter change. First, it changed into something called kerogen – which is found around the world today in oil shale. Over time, with additional heat and pressure, the kerogen then turned into liquid and gaseous hydrocarbons. The gaseous hydrocarbons are what we now call “natural gas,” and they are found as a layer, or cap, over the petroleum. It is this gas that we see burning off in many famous pictures of oil wells, as the gas comes out when the petroleum is pumped from the earth.

What types of oil are there?

Though this process might sound relatively simple and homogeneous, it actually results in very different types of oil depending on where in the world the oil is found, its sulfur content, and its density. The petroleum industry takes account of this by classifying oil according to where it is produced and its density. Each class of oils is valued at a different amount, so the prices of classes of oils vary. Crude oil can also be called *light* (low density), *heavy* (high density), *sweet* (low sulfur) or *sour* (high sulfur).

Light, sweet oils are the most desirable. There are a series of alternative oils, however, that could become economical to extract, should oil prices rise considerably, or as reserves of oil are depleted:

Heavy oils

Heavy oils are very similar to normal oil, except that they are more polluting, require more refining and are much thicker. They can be found all over the world, but the vast majority of heavy oil is to be found in Venezuela, which has an estimated 1.2 trillion barrels. Using current methods, we could access about a third of this oil.

Tar sands

Tar sands are actually sedimentary rock that contains oil. This means that to extract the oil, the rock or sands need to be dug and then crushed. It takes between five and ten times the energy to process these tars to extract the oil as it does to extract normal crude oil. The Athabasca deposits in Canada contain vast reserves of tar sands: an estimated 1.8 trillion barrels.

Oil shales

Like tar sands, oil shale is a type of sedimentary rock. It needs to be heated to extreme temperatures to extract the oil from within. The World Energy Council 2007 Survey of Energy Resources places the total world reserve of oil shale at 3.3 trillion barrels – over twice as much as the estimated reserve of conventional crude oil. It is prohibitively expensive to get oil shales out of the ground with current technology, however. Moreover, many of the richest sites in the United States are in ecologically sensitive zones.

How do you get oil out of the ground?

First, you have to find it! Today, oil companies use a wide variety of techniques to look for oil. These include core sampling, which tests sections of rock for petroleum content, and seismic testing, which tests vibrations from shock waves, matching them to those commonly associated with petroleum. Advances in these techniques have increased the probability that drilling will be successful, but to confirm that there is truly gas or oil, one must drill into the earth.

When it is confirmed that oil has been found, multiple wells are usually drilled. Through these wells, the oil company determines the extent of the reservoir and the conditions of the oil beneath the surface.

One of the most important things about an oil well is the level of pressure underneath the surface of the earth. This is determined by the type of rock in the location and by the state of production a well is at. When a well is first drilled, the pressure is usually sufficient to lift the oil out of the ground on its own. Over time, however, oil companies have to use pumps to get the oil out of the ground. These pumps lose effectiveness over time, so oil companies resort to water or chemicals to force the oil to come to the surface. These procedures become increasingly expensive.

Oil companies construct tanks, pipelines and gas processing plants to move the oil to the marketplace. Before arriving at the market, however, oil needs to be distilled or refined. There is a mixture of hydrocarbons in crude oil. To make oil we can use, oil companies separate out the various hydrocarbon components. To do so, crude oil is heated. At various temperatures, different components, or products, separate out and can be recovered or collected.

How do you move oil around?

To move oil from the well to the refinery and then to the market, there are two types of transportation normally used: tankers and pipelines. Some of the tankers, or ships, used to transport oil of the Middle East to the United States are so large – carrying over two million barrels of oil – they can only fit into one port in the country, in Louisiana. Before the petroleum arrives in the U.S., large tankers usually transfer their cargo onto smaller vessels. This happens at sea, or at offshore ports.

For crude oil found inland, pipelines are crucial. They transport oil at much cheaper costs than transporting oil by road or rail. Because they are exposed, however, they are very vulnerable to being disrupted.

Further questions for discussion

Small groups may be useful for discussion of the following questions. Is oil a different type of commodity than something like wheat? What might make it different? If you were in charge of a country that has just discovered oil, what conditions would need to be in place to ensure that you could successfully export your oil and make a profit?

Further reading

Speight, James G. (1999) *The Chemistry and Technology of Petroleum*. Marcel Dekker.