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What is petroleum?

When a drilling rig punches a hole in an underground formation, several things can come up from the ground including are water, crude oil, and natural gas. Crude oil and natural gas are petroleum. Many things are made from crude oil after it is processed at a refinery. The familiar things that come from oil are gasoline, kerosene, plastics, and paraffin. Paraffin is what most candles are made of. Also there is a very heavy, thick form of crude oil that might be called tar or pitch. Heavy crude is what makes asphalt black.
Natural gas is petroleum in its lightest form. Natural gas is a very good fuel. It is refined because there are different types of gas within natural gas.

**The use of petroleum in ancient times**

Tar, or heavy petroleum, has been used for thousands of years as a waterproofing material. It was useful to keep water out of boats and buildings. Occasionally natural gas would seep from out of the ground and be ignited. It must have been a wonder to ancient people to see fire coming from the ground. In the ninth century Persians produced kerosene and used petroleum as medicine. The Chinese and Japanese used natural gas for lighting in ancient times.

**Lubricants**

One of the earliest uses for oil was as a lubricant. From ancient times to the present day, oil has been essential for its ability to reduce friction between moving parts. Without lubrication, many machines would soon grind to a halt. As moving parts rub against each other, the surfaces where they meet become rough, which produces increasing amounts of friction.

For thousands of years, the oil portion of petroleum has been used to reduce friction and make devices work faster and smoother and last longer.

**Crude Oil**

When oil comes out of the ground, it is called "crude" because nothing has been done to it to alter its composition. Some crude is thick, black, and heavy. Other kinds of crude are light colored and flow easily. To make gasoline and other products, producers
prefer what is called sweet crude. It is called sweet because it has a slightly sweet taste. It is easier to make gasoline, kerosene, and diesel fuel from sweet crude, so it brings a higher price on the market.

**Early methods of collecting petroleum**

In some cases oil and tar could be found in a naturally occurring pond where the petroleum could be scooped up. When that was not available, petroleum might be accessible through drilling.

**Early drilling methods**

The illustration above shows the spring pole method of drilling. There might be two stirrups so that two people could push the spring pole down. When the pole is pushed down, the drill bit drops to the bottom of the well bore forcefully. Then the driller lifts his leg, and the pole springs back to its normal shape and position. This is done repeatedly. With luck and a lot of hard work, the bit penetrates a formation that holds petroleum.
Cable tool drilling is very similar to the spring pole method, except that the steam engine provides the power to raise and lower the drill bit. Just like with the spring pole, the cable tool pounds its way down until the driller finds oil or gives up. Cable tool drilling was used from about 1810 to the end of World War II in 1945.
**Kerosene**

Gas-powered automobiles started being produced in large numbers in 1900. Until then, there wasn’t really much use for gasoline, so the main attraction to oil was the production of kerosene and lubricants. Kerosene was used extensively for lighting in homes and businesses. It was also used for cooking and heating. Kerosene is safer to use than gasoline because it does not explode. Today in remote areas, people who do not have or do not want to use electricity use kerosene as it has been used for centuries.

**Paraffin**

In 1830 paraffin was produced from petroleum, and it eventually became the type of wax that was used to make most candles. It is less expensive than beeswax, which was the type of wax that was mostly used before paraffin. Paraffin is also used as a sealant. For instance, canned foods are often protected from air infiltration with a wax seal. It is used to make crayons and to coat waxed paper. It can also be used as a coating to protect metals from corrosion.

**Gasoline**

Gasoline is the form of petroleum that we use daily. In 1900 automobiles, farm equipment, and other machines began using internal combustion engines that relied on the explosive power of gasoline to make them work. Gasoline is much more dangerous than kerosene because it can explode with great force, but that is what makes it a powerful fuel.
Refining

In most cases, petroleum straight out of the ground has to be refined before it is ready for distribution and sale. The first step in refining takes place near the well. Some wells have both oil and gas in the formation below. In some of those wells the gas is separated very easily from the oil by simply giving the gas a path through which it can escape. When a bottle of champagne or soda pop is opened the trapped gas comes out by itself. A well can sometimes work the same way. Other times there are additional steps required to separate the gas from the oil that can also be done near the well.

From the well, the petroleum goes to a refinery by pipeline or by truck. At the refinery, petroleum is separated into many more components. When you look at a refinery, you see a lot of pipes and a lot of tanks. That is because the petroleum gets separated into different components and each one is transported to its own storage where it will remain until it is needed somewhere.
Natural Gas

Natural gas is very important to Oklahoma. It is even more important than oil. Oklahoma is the second-largest producer of natural gas in the United States. Gas production creates thousands of jobs and provides the cleanest fossil fuel. Increasingly, natural gas is being used to fuel cars, buses, and trucks because it produces relatively little pollution. Most homes use natural gas in one way or another, and even the homes that do not are often using electricity that was produced by burning natural gas.

When gas comes out of a well, it is usually made of several components. What is typically used in homes for heating and cooking is methane. Most natural gas is methane. However, there are also butane and propane combined with the methane. At the refinery, methane, butane, and propane are separated from each other. Butane is used in torches and lighters. Propane is often used in outdoor grills, but it can also serve as heating fuel in many rural homes.

Because the demand for natural gas fluctuates with the seasons, gas is often stored underground as it is produced and refined. That way, when winter comes and the demand for gas greatly increases, there is a large reserve on hand stored in old oil wells and in salt mines.
World War I and Its Impact on Oklahoma Petroleum

From 1907 to 1928, Oklahoma was the largest oil-producing state in the nation. World War I was fought between 1914 and 1918 and the demand for oil dramatically increased. The biggest producing field during the war was the Glenn Pool near Tulsa. Oklahoma oil was a vital resource for winning the war, and the Glenn Pool provided for most of that need. The towns of Glenpool, Sapulpa, Jenks, Mounds, Keifer, and Tulsa experienced tremendous population growth and prosperity. Tulsa quickly became "the oil capital of the world."

Rotary Drilling

Until the end of World War II, cable tool bits were the only kind of drilling equipment that was used. In 1945 drilling began to change in a big way. Rotary drilling gradually became the normal way to drill. Instead of the drill bit going up and down, it rotated.

A rotary bit rotates and grinds with its steel teeth. Some rotary bits have teeth with diamond tips because diamonds last longer than steel. With both cable tool and rotary drilling, rock is crushed, and small pieces of rock accumulate and get in the way of the drill bit. A rotary bit is screwed onto the end...
of a series of hollow pipes. As the pipes turn, the bit turns. Mud is pumped down through the pipe. The mud comes out through the drill bit. The mud picks up little pieces of rock, or cuttings. The mud is pushed by a very powerful engine that applies so much pressure that it picks up the cuttings and returns to the surface carrying its load. As the mud flows through the bit, it also cools and lubricates it.

The picture on the right shows a rotary drilling rig. It is called a jackknife rig because it can fold down like a folding pocket knife. Older derricks were built one piece at a time from the ground up. When they were no longer used, they were also disassembled one piece at a time. A jackknife rig is much faster and easier to set up and take down.
Getting the Oil Out Of the Ground

The image on the right shows an event that we often associate with oil wells. What is happening is called a gusher or a blowout. Gushers were common in the early years of oil field work but not so much today. In the case of a gusher, natural pressures send the oil rushing to the surface. The reason it flies into the air is similar to why champagne or soda pop flies out of a bottle when it is opened. The liquid stays in the bottle until the cap is removed. At that time, the pressure that had been there all along is able to vent. Gases combined with the liquid propel both liquid and gas out of the bottle. An oil well that is gushing is very similar to the pop bottle. When the pressure in the formation has dissipated, the gusher stops. That may take seconds or months.

The picture to the left shows a Christmas tree. It is called a Christmas tree because it resembles a tree trunk and limbs, and the valve handles resemble ornaments. When natural pressure in the formation causes petroleum to come to the surface, a Christmas tree installed on the well head makes it possible to control flow rate and the direction that it will go. With this particular Christmas tree, it is possible send petroleum to as many as seventeen different destinations. Also, if the price of petroleum falls, the owner may choose to stop the flow entirely until the price comes up to an acceptable level.
Many formations do not have pressure trapped inside, so when they are punctured by a drill bit, nothing happens. When that is the case, the oil must be pulled to the surface with a pump. There are thousands of pumps like the one pictured to the left. In the United States never had much pressure or the pressure has diminished as oil and gas flowed out. Consequently most oil wells have pump jacks on the well heads. The oil goes into a tank nearby where it will accumulate until it is hauled away by truck.

**Horizontal Drilling and Fracturing**

The horizontal well bore is perforated. Then fluids are pumped under pressure to open cracks in the formation to release oil and gas. Then material is injected to hold the cracks open.

Today horizontal drilling is used on many wells because there are rock formations which are long and thin that hold petroleum. In formations like that, vertical drilling provides access to only a small producing zone whereas
horizontal drilling greatly increases the size of the penetrated producing zone. If the formation is not porous enough to allow petroleum to flow into the well bore, it is perforated and fractured to release trapped oil and gas. Then they can flow into the well bore and come to the surface.

**Oil Field Work**

Work at a drilling site ranges from highly technical jobs that require advanced training to work that is mainly manual labor that requires little training.

- Roustabout is the lowest position. This person has little or no training and does very physical work.
- A floor hand is a person who works on the drilling floor and moves pieces of equipment into position and makes connections or breaks connections. This person may also be called a roughneck.
- A boiler man was a position on a drill site before World War II. In that era, power on a drill site was provided by a boiler that produced steam to provide power.
- The motor man is the person whose job is to make sure the engines, pumps and water lines work.
- The derrick man does two jobs. He is responsible for the drilling fluid also called the mud. He also works up high in the derrick to move the drill pipe when the drill bit has to be changed. This is called tripping.
- The driller is in charge of an eight hour crew.
- The toolpusher is in charge of everything on the drill site.
Rig builders used to build rigs piece by piece from the ground up. Now a rig is hauled to a drill site where it is erected largely as a ready-made unit.

The shooter was a person who performed one of the most dangerous jobs on the drill site. This position has been replaced by other specialists. The shooter went to a well because the driller felt that the well should be producing petroleum at this point. He felt that what was needed was to break open the formation to allow the oil and gas to escape. The shooter came to the site with a very powerful and dangerous explosive called nitroglycerin. He filled tubes with nitroglycerin and lowered them into the well bore. When he had loaded the amount that the driller asked for, he would detonate it. This would be followed by a tremendous explosion underground and, in some cases, above ground as well.

**Workers’ Safety on the Drill Site**

Oil field work typically pays well and provides opportunity for people who like challenging, physical work outdoors. Many people have been able to afford a higher standard of living than they had otherwise expected because of oil field work. However, there are risks to this work. They range from strained muscles to traumatic amputation to sudden death.

Everything on a drill site is heavy because everything is made of heavy metal that has to withstand big loads. When a drilling hand picks up
something there is the potential to strain muscles, ligaments, and joints. However he may not have time to lift it correctly because it may have to be done very quickly.

In the early days of the oil field, workers did not wear hard hats, and some did not even wear gloves. For many years, drilling hands worked twelve hours a day with nothing to protect themselves except their wits and their strength.

Boilers could explode; a chain could get wrapped around a hand and pull on it. Derricks sometimes collapsed and killed everyone on the drilling floor. A person could be kicked by a mule or run over by a truck. There were many things that were heavy, sharp, hot, and moving with great speed and force.

In the early years, hands worked twelve-hour days with no days off. If a worker got sick or injured, he was on his own. There was no insurance, no workman’s compensation, no one besides his family to take care of him or his family if he were injured or killed.

Today there is health insurance and workman’s compensation, shorter hours and days off. There are more work practices and equipment to make the work safer, but it is still dangerous.

The Development of Biofuels

There are parts of northwest Oklahoma where there aren’t many farms because the soil is not good enough to grow the kinds of things that farmers usually grow like wheat, cotton, or soybeans. That may change soon.
A plant called switch grass may become a great source for biofuel. Oklahoma has 34 million acres of crop and pastureland. If just half of that land was used to grow high-yielding switch grass for ethanol production, Oklahoma could produce the equivalent of 1.3 million barrels of oil a day, rivaling the output of some members of OPEC. A blend of biofuel and gasoline is increasingly being used to run cars, trucks, lawn mowers and other machines.

Switch grass is being studied to see if it would be good for making biofuel. Switch grass would grow very well in northwest Oklahoma, and this would be good news for farmers in that part of the state, because then they could use that land to raise a crop that would make money.

As you can see, switch grass grows very tall. Another nice thing about it is that when the grass is harvested, it will grow back from the roots that are still there. This is useful because switch grass does not have to be replanted year after year. It just grows back like the grass in someone’s yard at home.

Biodiesel From Pork

Two Oklahoma companies in Guymon worked to develop biodiesel from pork. Seaboard Foods produces pork. Pork fat from Seaboard Farms is used by High Plains Bioenergy, which turns the fat into biodiesel fuel. About half of the biodiesel that they make comes from pork fat and the other half comes from beef fat.
Some truckers use diesel that comes partly from oil out of an oil well and partly from grease and fat turned into biodiesel in Oklahoma. Biodiesel does not pollute the air nearly as much as diesel from oil, and it reduces America’s reliance on foreign oil.

Biofuel is also made from Oklahoma soybeans. The bus in this picture runs on biofuel.