THE TRANSPORTATION OF OIL AND GAS.*

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When an oil well is completed, it either flows naturally or is pumped into a tank situated near the well. From this tank, the usual methods of transporting the oil to the refineries are by tank cars or through pipe lines. (Boat transportation is good and cheap if location of wells permits.) When tank cars are used, it is customary to gather the production from a number of wells through a system of pipe lines and to conduct it to some point located on a railroad. Before the production of a field reaches an amount sufficient to warrant the building of a pipe line, the oil is either collected in tanks and allowed to stand, or, if there is a railroad convenient, shipped by cars. After a field is developed enough to warrant a pipe line system for gathering the oil, there is run, from the producers' tanks at each individual well, a pipe line which connects with other similar lines leading to a point of concentration. The oil is either forced through these lines by a pump located at the well, run by gravity, or run into a system of lines having a suction pump at their terminus. The gravity system is to be preferred where it is possible to use it, even though it often requires larger lines. Where the oil is nearly as fluid as water, a pipe about 2-in. in diameter is used, but where the oil is viscous, larger pipes are necessary, the size, of course, depending on the amount of oil to be handled. With the same head, the more liquid oils flow about the same as water, but, when the oil becomes viscous and thick, the flow is very much reduced. The fluidity of the more viscous oils changes with the temperature. In general, the heavier oils are the most viscous, but there are many notable exceptions to this rule. The gravity of the oils is usually obtained by a Baumé hydrometer. The specific gravity of the oil can be obtained by substituting the Baumé gravity in the formula:—

$$\text{Sp. gr.} = \frac{144}{134 + \text{Baumé degrees}}$$

After the oil has been collected by the gathering system into the first concentration tank, it can be pumped through lines to some point of storage, or through a series of pump stations to the places where it is to be refined. There is a great difference in the crude oils, some of them being black, brown, or dark red; while others are amber or straw colored. As these lighter colored oils are often of more value than the darker, it is necessary to keep the different grades separate. This can only be done by pumping through separate lines, or handling the oil in large consignments. The history of the pipe lines dates back nearly to the discovery of oil in large quantities. The first successful pipe line in the United States was built in 1865. This line was only four miles long, but they were able to pump 81 barrels of oil per day using three pumps. Since that time the pumping machinery has improved in line with other machinery being built. At first, high-pressure steam-driven pumps were used, the steam being used but once. This was followed by the introduction of the compound pump, then the triple pump, which later gave place to the high-duty triple expansion condensing fly-wheel type of pumps. The first style of pumps required about 120 lbs. of water, converted into steam, per h.p. per hour. The last type of steam pumps require about 15 lbs. One pound of oil will evaporate about 15 lbs. of water, so that a pound of oil burned under a boiler with a good triple expansion pumping engine will furnish a h.p. for one hour. Recent developments in the oil engine have resulted in producing an oil engine driven pump which will furnish a h.p. per hour on less than 0.5 lb. of oil. In 1902 and 1903 the writer built a pipe line for handling the viscous California oil. The oil was heated by a surface heater using the exhaust steam from the pumping engines. This heating system is now in general use where viscous oils are to be handled.

In the United States, the pipe lines take the oil from the producer's tank, gauging the tank before the oil is run into the pipe line system and after the run has been completed, care being taken to see that all of the water has been drawn from the tank before the run starts, and that the valves and connections are all tight so that no water or oil can come into or leave the tank while the oil is being run into the pipe line. It is customary for the pipe lines to seal or lock their valves when oil is not being run from the producer's tanks. Where the oil is handled by a pipe line company not owning the production, the company furnishes the owner's representative at the well with a statement showing the level of the oil before starting to run, the level at the close of the run, and the number of barrels of oil taken from the tank as shown by the engineer's table. In the United States, the barrel contains 42 U.S. gal. of 231 cu. in. each. This is equivalent to 35 Imp. gal. There is generally some water and sediment in the oil coming from the wells and also considerable gas. For this reason, it is necessary for the oil to stand for some time before it is measured and run into the pipe lines. Even when this precaution is taken, it is found the lighter gravity oils, containing considerable gasoline, lose some in volume; for this reason, it has become a question to allow a certain percentage of difference between the gauge of the producer's tanks and the gauge in other tanks along the lines. With the light gravity oils, this loss amounts to about 2% of the oil run which is the figure used in most of the fields producing light gravity oils. The heavier oils carry more water and sediment and hold them suspended for a long time. In handling the oils through pipe lines, it is necessary to be very careful around the pumping stations and keep fire or lights away from the oil or its fumes. Fires are often caused around the pumping stations and tankage fields by lightning. It has been found that a steel tank with a steel roof is not as liable to be struck by lightning as a steel tank with a wooden roof. Where there is a large tankage field, it is necessary to build banks around the tanks, or place them far enough apart so that when one is on fire it will not endanger others. Lightning rods have been used to prevent lightning striking the tanks, but it is generally considered that their value in preventing the loss by lightning does not warrant the additional expense. Where tanks are located near power plants having steam available, a steam pipe is connected into the top of the shell of the tank, so that, in case the tank is struck by lightning, steam can be turned in above the oil. If the roof of the tank is not blown off by the explosion, it is often possible to put out the fire in this manner. Care is to be taken to see that all of the openings in the tops of the tanks are closed to retain this steam. If water is available, it is the practice to play water on the adjacent tanks and sometimes on the tank which is on fire. This can be done with reasonable safety for a few hours after the tank has been struck. Oil is sometimes drawn off from the tanks by connecting pipe line systems and water forced in at the bottom to keep the burning oil as high as possible. By this means

* From a recent Department of Mines' report on the Petroleum and Natural Gas Resources of Canada.