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(Storage and transportation of petroleum products)

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Lecture (5)

PIPELINE NETWORK:

Pipelines may be small or large, up to 48 inches in diameter. Nearly all of the mainline pipe is buried, but other pipeline components such as pump stations are above ground. Some lines are as short as a mile, while others may extend 1,000 miles or more. Some are very simple, connecting a single source to a single destination, while others are very complex, having many sources, destinations, and interconnections. Many pipelines cross one or more state boundaries (interstate), while some are located within a single state (intrastate), and still others operate on the Outer Continental Shelf and may or may not extend into one or more states. U.S. pipelines are located in coastal plains, deserts, Arctic tundra, mountains, and more than a mile beneath the water's surface of the Gulf of Mexico (Rabinow 2004; AOPL 2006).

It is generally the case that all crude oils, natural gas, liquefied natural gas, liquefied petroleum gas (LPG) and petroleum products flow through pipelines at some time in their migration from the well to a refinery or gas plant, then to a terminal and eventually to the consumer. Aboveground, underwater and underground pipelines, varying in size from several centimeters to a meter or more in diameter, move vast amounts of crude oil, natural gas, LHGs and liquid petroleum products. Pipelines run throughout the world, from the frozen tundra of Alaska and Siberia to the hot deserts of the Middle East, across rivers, lakes, seas, swamps and forests, over and through mountains and under cities and towns. Although the initial construction of pipelines is difficult and expensive properly maintained and operated, they provide one of the safest and most economical means of transporting these products.

FLUIDS HANDLED:

The products carried in liquid pipelines include a wide range of materials. Crude oil systems gather production from onshore and offshore fields, while transmission lines transport crude to terminals, interconnection points, and refineries. The crude oil may be of

domestic origin or imported. Refined petroleum product, including gasoline, aviation fuels, kerosene, diesel fuel, heating oil, and various fuel oils, are sizable portions of the pipelines business, whether produced in domestic refineries or imported to coastal terminals. Other materials include petrochemical feedstocks (also known as secondary feedstock) such as benzene, styrene, propylene, and aromatics such as xylene, toluene, and cumene that are delivered by pipeline from refineries to petrochemical production plants or to other refineries. Also carried by pipeline are liquefied petroleum fuels such as liquefied natural gas (LNG) (albeit over relatively short distances), liquefied petroleum gas (LPG) and propane, all of which are gases at standard temperature and pressure but easily liquefied with the application of pressure.¹ Still other materials transported by pipelines include carbon dioxide and anhydrous ammonia, both transported as liquids under their own pressure.² In recent years, long-distance pipelines have been constructed to carry distillate fractions from the distillation of crude oils from refineries to production facilities for crude feedstocks such as bitumen recovered from tar sands and heavy oils. Such feedstocks are too viscous to be transported by pipeline. However, the distillate fractions are used to dilute these feedstocks, with the resulting mixture being suitable for delivery back to the refinery by pipeline for further processing. Also in recent years, long distance pipelines have been constructed to carry “produced water”³ from oil and gas fields to refineries and other industrial facilities that use copious amounts of water, but are located in arid areas or areas where water availability is limited. Hydrogen is also delivered by pipeline, albeit over relatively short distances, typically connecting hydrogen production facilities with refineries and other industries that use hydrogen as a starting material in their processes.

TYPES OF LINE PIPE:

Steel pipe is used in most pipelines transporting hydrocarbons. It is manufactured according to the specifications of the American

Petroleum Institute (API 1994, 2000), the American Society of Mechanical Engineers (ASME), the American National Standards Institute (ANSI), and the American Society of Testing Materials (ASTM).

Line pipe is manufactured as either seamless or welded. These designations refer to how each length, or joint, of pipe is manufactured, not how the joints are connected in the field to form a continuous pipeline. Seamless steel pipe is made without a longitudinal weld by hotworking lengths of steel to produce pipe of the desired size and properties. Welded pipe is made using several manufacturing processes. The two types of pipe differ both by the number of longitudinal weld seams in the pipe and the type of welding equipment used. Welded pipe is the most common pipe used in petroleum pipeline service.

Types of pipelines: The four basic types of pipelines in the oil and gas industry are flow lines, gathering lines, crude trunk pipelines and petroleum product trunk pipelines.

- **Flow lines:** Flow lines move crude oil or natural gas from producing wells to producing field storage tanks and reservoirs. Flow lines may vary in size from 5 cm in diameter in older, lower-pressure fields with only a few wells, to much larger lines in multi-well, high-pressure fields. Offshore platforms use flow lines to move crude and gas from wells to the platform storage and loading facility. A lease line is a type of flow line which carries all of the oil produced on a single lease to a storage tank.
- **Gathering and feeder lines:** Gathering lines collect oil and gas from several locations for delivery to central accumulating points, such as from field crude oil tanks and gas plants to marine docks. Feeder lines collect oil and gas from several locations for delivery direct into trunk lines, such as moving crude oil from offshore platforms to onshore crude trunk

pipelines. Gathering lines and feeder lines are typically larger in diameter than flow lines.

- **Crude trunk pipelines:** Natural gas and crude oil are moved long distances from producing areas or marine docks to refineries and from refineries to storage and distribution facilities by 1- to 3-m- or larger-diameter trunk pipelines.
- **Petroleum product trunk pipelines:** These pipelines move liquid petroleum products such as gasoline and fuel oil from refineries to terminals, and from marine and pipeline terminals to distribution terminals.

