

CHAPTER 1 INTRODUCTION TO HYDROCARBONS PRODUCTION FROM RESERVOIRS

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1.1 HYDROCARBON AND MANKIND

Energy is very important to mankind. It helps them to carry out their daily activities such as moving from one location to another location using vehicles (Figure 1.1), lighting up and cooling down their houses and offices, constructing houses and high-rise buildings, processing and manufacturing consumers' food products and utilities, drilling into the Earth's crust to produce more crude oil and gas, etc. The main source of energy that complements their needs is the hydrocarbons. The continuous usage of non-renewable hydrocarbons has led to the dwindling of easy hydrocarbon resources worldwide and at the same time has caused massive problems for mankind such as air pollution and global warming (Petronas, 2015).

Due to worsening air quality and global warming from time to time, nowadays all nations around the world are working continuously to find the best alternative of renewable energy that can reduce their dependency on the non-renewable hydrocarbon. Among the notable ones are solar, wind, and hydrogen cells. But until now, there is no better alternative source of renewable and friendly energy that can substitute for hydrocarbons. Demand for non-renewable hydrocarbons continues

to rise from time to time and it is not surprising to see that many oil-rich countries are facing local and international conflicts, such as Sudan, Iran, Libya, etc., to have full control over the non-renewable hydrocarbon resources.



Figure 1.1 Transportation is one of the largest energy consumption sectors

1.2 WHAT IS HYDROCARBON?

Hydrocarbon which comprises crude oil and gas is a simple word that originated from ‘hydrogen’ and ‘carbon’. They are formed by the two in the form of molecules. Examples are methane (CH_4) and ethane (C_2H_6) which form dry gas while oil comprises lighter to heavier components such as butane (C_4H_{10}), pentane (C_5H_{12}), etc.

Crude oil and gas can be found in reservoirs that are located in the Earth’s crust. They originated from kerogen which was formed millions of years ago mainly by dead algae and plankton that sank to the seabed and were buried by layers of different lithologies, such as silt, shale, limestone, dolomite, and sand layers. In the early days, men discovered crude oil via seepage to the surface, and it was mainly used for medicinal purposes. But Colonel E. Drake was the first man to officially find crude oil in Pennsylvania via the world’s first drilled oil well. The discovery was made in August 1859 (Dyke, 1997).

1.3 A WELL

Crude oil and gas are produced from the Earth's crust through a drilled hole. The hole can be drilled in a vertical, deviated, or horizontal manner which depends on the target depth in a reservoir in relation to the location of a drilling platform (Pettijohn, 2012). Four holes may be drilled during a well construction; the conductor hole (as the topmost hole), the surface hole, the intermediate hole, and the production hole (as the bottom most hole). A casing string is run into its respective hole and cemented in place before the subsequent hole is drilled. For example, a surface hole can be drilled after a conductor casing string has been run into the conductor hole till its setting depth and cemented in place.

After the final casing string which is the production casing string has been run into the hole and cemented in place, the well will be completed (Ismail, 2003; Ismail, 2018). The well may be completed as single completion, dual completion, triple completion or multiple completion with flexibilities in its tubing strings, depending on the number of production zones that it has penetrated, the company's production strategy, reservoir conditions, global oil prices, etc. Figure 1.2 shows a single completion that has been perforated before it can be released to production.

1.4 DRILLING FLUIDS

Drilling fluids (also known as drilling mud) are used to drill different sizes of holes in a well. It may start from a simple formulation of drilling fluid which comprises brine mixed with viscous pills when drilling a conductor hole to a complex mixture of additives when drilling intermediate and production holes. The complex formulation may consist of bentonite, barite, soda ash, caustic soda and others in water as the continuous phase and eventually it's known as water-based mud. In oil-based mud, environmentally friendly base oils such as Sarapar and Novasol are used as the continuous phase. These two drilling fluids—water-based mud and oil-based mud—are widely used in drilling operations (Rabia, 1986).