CHAPTER I

INTRODUCTION

With the advent of deeper drilling, high pressure gas reservoirs have been discovered with properties materially different from those of the "dry" gas reservoirs. The composition of fluid is still predominately methane, although the relative amount of heavier hydrocarbons are considerably increased. These reservoirs fluids are commonly called ***"gas condensate fluid"*** and the reservoirs are referred to as ***"gas condensate reservoirs"***.

Gas condensate reservoirs are one of the various types of reservoirs which may be thought of as a type intermediate between oil and gas. It has unique characteristics of phase behavior as illustrated in Figure 1.1, schematically. This reservoirs initially lies outside the two phase region, it is originally in one phase state, commonly called gas as located at point A where its pressure is above the ***dew point*** (point C). Below this pressure, liquid condenses out of the reservoirs fluid as a ***fog*** or ***dew***. As the condensed liquid adheres to the walls of the pore spaces of the rock, it is immobile. Thus, the gas produced at the surface will have a lower liquid content, and the producing gas-oil ratio therefore rises. This process of retrograde condensation continues until a point of maximum liquid volume is reached (point D). Lowering the pressure will cause the liquid to ***re-vaporize*** (point E). In typical field operations, this pressure is below the economic life of the field, and this stage of re-vaporization will not be reached. The fluid produced through the wellbore and into surface separators, through of the same composition, may enter the two phase region owing to the temperature decline, as along line A-F. And when the reservoirs fluid reaches the surface, pressure will drop due to hydrostatic and friction pressure and also temperature (point F). This accounts for the production of condensate liquid at the surface from gas in the reservoirs.

To maximize condensate production and to prevent condensate dropout which is immobile liquid in the reservoirs, the reservoirs pressure must be maintained above the ***dew point*** (point C). A condition could be achieved by injecting gas into the reservoirs. The injected gas can be natural gas or inert gases, depending on gas availability for each reservoirs. Injection of natural gas produced from the reservoirs is known as 'Gas Cycling' or 'Gas Recycling'. During this process, condensate is vaporized into the mobile gas phase since the reservoirs pressure is increased (point B). This gas injection method to improve well productivity is often included in the production plan for 'Gas-Condensate Reservoirs'.

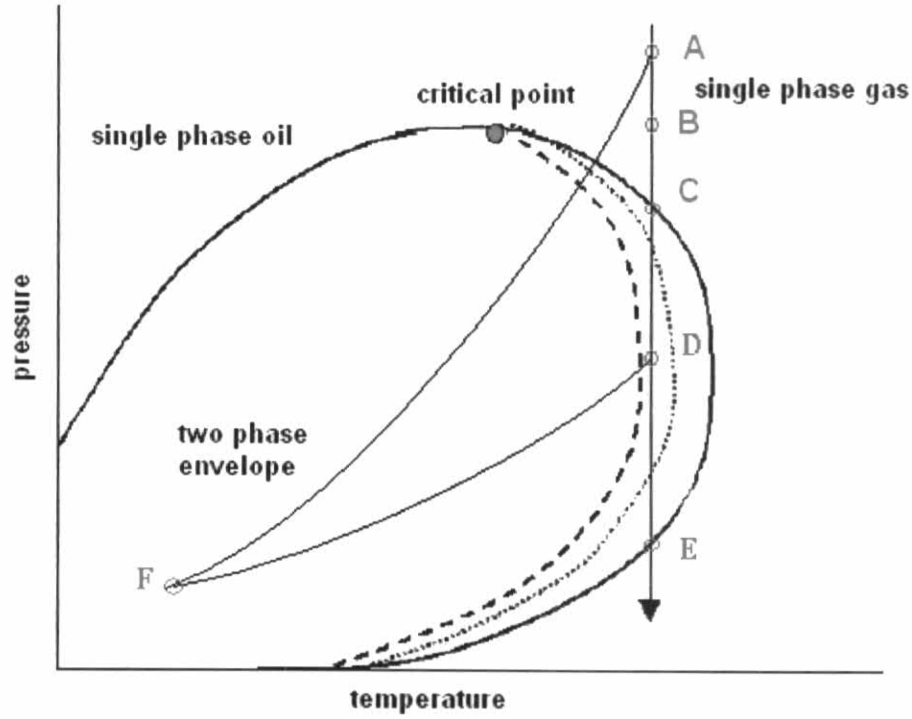

Figure 1.1 Pressure-Temperature diagram of condensate.

However, since the prior produced natural gas will be used as injected gas instead of the product to sell, condensate production planning must be certain and strictly reviewed for pros and cons. For a fixed period of well production, implementation of this gas recycling will be designed to maximize hydrocarbon recovery. Those gas recycling characteristics may include production/injection well ratio, reservoirs fluid composition, injection rate, amount of recycled gas inject, etc. However, reservoirs fluid composition is one of the most important properties which significantly affect the recovery of gas and condensate.

1.1 Outline of Methodology

This thesis studies the effect of reservoirs fluid composition on gas recycling in gas condensate reservoirs to maximize the condensate recovery for gas-condensate reservoirs. Compositional reservoirs simulations are performed to study two sets of scenario as listed below:

(a) Produce hydrocarbon from the reservoirs with natural depletion until economic limit of gas production.

(b) Start producing hydrocarbon from one well together with gas injection in another well. After the oil production rate reaches the economic limit, the injection well is then switched to produce gas in parallel with the first well. The two wells continue to produce until economic limit of gas production.

The results are then summarized. Economic analysis is performed based on NPV, IRR, and Payback period.

1.2 Thesis Outline

This thesis consists of six chapters.

Chapter II outlines a list of related works/studies on gas-condensate reservoirs and gas injection in order to study the effect of reservoirs fluid composition.

Chapter III describes the theory of gas-condensate reservoirs, and the applications of economic and its decision tools used to assess each set of reservoirs fluid composition for the hydrocarbon recovery of gas-condensate reservoirs

Chapter IV discusses the principle of reservoirs simulation, data required by the simulation program, and economic model.

Chapter V discusses the results of reservoirs simulation obtained from different sets of reservoirs fluid composition.

Chapter VI provides conclusion and recommendation for further study.