CHAPTER I
INTRODUCTION

Present industrial development is characterized by the consumption of large quantities of petroleum. While a demand of energy from fossil fuel is continuously increased every year, the petroleum production worldwide becomes difficult and requires new developments in technology which raises the world oil prices. Phase sequences of crude oil production from a reservoir based on difficulty of production are primary, secondary and tertiary (enhanced) oil recoveries. Enhanced oil recovery (EOR) processes have become increasingly important to the petroleum industry, since after the primary and secondary oil recovery, residual oil saturation in an oil reservoir is still in a range of 50–60 % of the original-oil-in-place (OOIP). There are three major categories of EOR, thermal recovery, gas injection and chemical injection. The thermal and chemical recoveries are the most commonly used in EOR process; however, production cost of thermal and chemical recoveries are higher than gas injection. Gases commonly injected in EOR include flue gases, mixture of hydrocarbon (HC) gases (or enriched gases), nitrogen, methane, and carbon dioxide. Nitrogen injection is the lowest cost compared to the other gases, but nitrogen and also flue gas can achieve miscibility at higher MMP than HC gas and CO_2 at the same reservoir conditions (Ezekwe, 2011). Additionally, flue gas is not common because it has high economic value for other process and is high corrosion. CO_2 injection is high potential for EOR because CO_2 reacts with the reservoir rock and fluids to improve the oil mobility, such as oil viscosity and interfacial tension reduction, oil swelling, and extraction of lighter components which are the principal mechanisms contributing to CO_2 EOR processes. In addition to use CO_2 for EOR, CO_2 can be disposed and stored in the oil reservoirs, since CO_2 is one of greenhouse gases (GHG) which has to be reduced. Moreover, CO_2 can be used at low pressure than other gases and its purity can be at least 95%wt, and its impurity, such as nitrogen, methane, and oxygen, is below 4 %wt. (Vandenhengel and Miyagishima, 1993). Which nitrogen from flue gas and CH_4 from reinjected CO_2 are the most likely contaminants in CO_2 and recycled CO_2

To inject CO_2 to a reservoir to enhance the oil mobility, it is important to know minimum pressure of CO_2 required being miscible with the oil, which it is depending on the reservoir condition, such as reservoir temperature, oil composition, and purity of CO_2 injected. The CO_2 injection process requires the miscibility between oil and CO_2 gas. A minimum pressure above which CO_2 miscible displacement can achieve is called minimum miscibility pressure (MMP). MMP of CO_2-oil system is mostly used to screen and select reservoir for a gas injection. MMP depends on reservoir temperature, purity of gas injected and oil composition. A factor that can effect on the miscibility achievement is the difference between reservoir pressure and MMP. If the reservoir pressure is higher than the MMP, a miscible drive forming with the injected gas, the recovery from the oil reservoir can be enhanced (Belhaj *et al.*, 2013). There are several methods to measure MMP, but most frequently used ones are slim-tube apparatus (Siagian and Grigg, 1998) and rising bubble apparatus or RBA (Dong *et al.*, 2001). Previous work used a modified pressure decay technique to measure MMP of CO_2-Thai crude system. MMP was measured by plotting total pressure drop against initial pressure and MMP was determined at the maximum pressure drop.

In this work, effects of impurity (Nitrogen) in CO_2, molecular weight and temperature on MMP of CO_2-Thai condensate were studied and the MMP was measured by using the modified pressure decay technique.