# CHAPTER I
# INTRODUCTION

Most of the energy used is derived from unrenewable source, fossil fuel, and its consumption is still growing due to the world economics growth (GDP – 5.1% in the year 2006), the increase in demand in developing country such as China and India, and the increase in the world population (6.5 billion people in July 2006) (www.cia.gov). The global energy consumption is expected to continuously increase from 350 exajoule in 1995 to 900 exajoule (exa, equal $10^{18}$) in 2040 (Okkerse *et al.* 1999), leading to the increase in fuel demand. But the fossil fuel has limited reserve, oil proven reserve is 1.326 trillion bbl in 2002 and natural gas proven reserve is 172.8 trillion bbl in 2005. These affect to the oil price and make fossil fuel shortage in the upcoming future. Moreover, the high consumption of fossil fuel derivatives has a great impact to environments. The combustion or reaction of the fossil fuel has released undesired products such as nitrogen compound, sulfur compound, carbon monoxide, carbon dioxide and particular matters in the atmosphere (Ogden *et al.* 1999, Steinberg *et al.* 1999, and Pehr *et al.* 2001)

According to a sustainable growth scenario and the environment effect, part of the fossil fuel should be replaced by renewable sources, such as wind, water, solar, biomass, etc. The alternative fuel is needed to raise the share up to 5.75% in 2010 (Schöpe *et al.* 2002). Thus, in the last decade, many researchers have been searching for renewable and sustainable energy sources to substitute the petroleum fuel. One of the promising renewable sources is biodiesel. The biodiesel is referred to a diesel equivalent, processed fuel derived from biological sources (such as vegetable oils), which can be used in unmodified diesel-engine vehicles. It has a beneficial impact on environment (e.g. less toxic emission, no particulate matters) and lower cost than fossil diesel fuel. Moreover, there are large possible source of raw material to produce biodiesel that are commonly grown in Thailand for example; jartropha, palm, and soybean.

The biodiesel is mainly produced via a transesterification reaction (Lee *et al.*, 1998, Srivastava *et al.*, 2000, and Demirbas *et al.*, 2002). Unfortunately the

product obtained from this process has higher viscosity, cloud point, and acid number than the conventional diesel fuel which cause possible engine problem and limit their applicability. However, biodiesel can also be performed via hydrolysis and deoxygenation reactions. The deoxygenation of biological feed, fatty acids, is typically related to pyrolysis, where the hydrocarbon chain is broken and the oxygen is removed. This process can produce the diesel-like hydrocarbons which have property similar to the conventional diesel fuel.

The main aim of this work is to deoxygenate fatty acids, derived from vegetable oil i.e. palmitric and oleic acids by heterogeneous catalysts in order to produce high quality renewable diesel with carbon number in the range of C16-C18. First of all, a high pressure continuous flow reactor was constructed for testing a number of commercial hydrogenation catalysts e.g. NiMo/$\gamma$-$Al_2O_3$, sulphided NiMo/$\gamma$-$Al_2O_3$, and Pd/C. The experiment was focused on the conversion of oxygenated feedstocks to diesel-fuel-like hydrocarbons. The optimum condition for deoxygenation of fatty acid was elucidated in this work. Furthermore, the product distribution as a function of equivalent contact time was done to understand the reaction mechanism.