# CHAPTER I
# INTRODUCTION

Crude oil and natural gas, which are feedstock for fuel and chemical production, are contaminated with several types of metals presenting in subsurface. Mercury is one of the contaminants that may exist in geological hydrocarbons. There are various forms of mercury such as elemental mercury, suspended mercury, ionic compounds, and organometallic compounds. Suspended mercury compounds, mainly mercuric sulfide, are the major form found in unprocessed gas and crude oil while the dominant dissolved species are elemental mercury and ionic halide. Ionic mercury compounds, which are significantly present in liquid, are not known exactly whether they are naturally abundant or they occur due to post collection conversion of other mercury species. In addition, dialkylmercury, the example of organometallic compounds, has been directly detected in a few crude oil samples but in a low concentration level (Wilhelm and Bloom, 2000). In fact, mercury has been detected and reported in petroleum fluids from a number of locations around the world. The areas especially affected are not only Netherlands and Germany, but also Canada, USA, Malaysia, Brunei, and latterly in North Sea (Edmond *et al.*, 1996). The concentration of mercury in crude oil and natural gas is greatly dependent on geological location and varies between approximately 0.01 ppb and 10 ppm (wt) (Wilhelm and Bloom, 2000). In Thailand, the Division of Pollution Control Department (PCD), Ministry of Science, Technology and Environment has reported that natural gas and condensate have mercury concentration of 10 – 25 $\mu g/m^3$ and 0.5 – 0.8 $\mu g/m^3$, respectively (Chongprasith *et al.*, 2001). Whereas, gas condensate in South East Asia has dissolved total mercury concentration in the 10 – 800 ppb range. Due to very low concentration, the sophisticated sampling techniques and analytical methods should be applied to accurately and precisely determine total mercury and speciation of mercury compounds.

Mercury and its compounds are defined as a hazardous substance and neurotoxins. The pathways that introduce them into humans finally result in neurological dysfunction (Wilhelm and Bloom, 2000). Mercury has not only effected the environment and human health but also directly impacted on petroleum and petrochemical processing. Mercury in feeds can cause catalyst poisoning, water polluting, and equipment corrosion. Mercury and its compounds are able to react with process equipment that is constructed by aluminum material, resulting in an amalgam form, which leads to equipment failure. Furthermore, corrosion of the equipment made of steel, chromium, brass, and other copper and / or zinc alloys is possible (Edmond *et al.*, 1996). Additionally, mercury can deposit in equipment and increase risk in health and safety of operators during inspection and maintenance operation (Wilhelm and Bloom, 2000). Therefore, mercury removal has become an important step in the process in order to protect the downstream equipment and environment from the effect of mercury mentioned above. This system will play a major role in reducing the mercury content into the lowest possible level.

Understanding about mercury solubility, existing form and transformation of mercury in hydrocarbons is very valuable for mitigating processing and environmental concerns. Temperature and pressure are the most important factors affecting solubility of mercury. Mercury speciation may also change when hydrocarbons are produced from high temperature reservoirs to surface ambient conditions. Consequently, this information will help the operator to specify the system that may overcome process and environmental problems caused by mercury contamination in petroleum fluids.

To date, the solubility studies of mercury have only been conducted in single solvent systems without examining for hysteresis. There are no reported solubility studies in mixed hydrocarbons or in simulated crude oils. Furthermore, the analysis of low concentrations of mercury in hydrocarbons has dramatically improved in recent years. In this work, the solubility of elemental mercury in cyclic, aromatic hydrocarbons, and simulated crude oil will be studied both by increasing temperature (5- 40°C) and decreasing temperature in the same range to determine hysteresis.