CHAPTER I

INTRODUCTION

Petroleum is complex mixture of hydrocarbons that occur in the earth in liquid, gaseous, or solid forms. Petroleum consists basically of compounds of only two elements, carbon and hydrogen. In addition to the infinite mixtures of hydrocarbon compounds that form petroleum, sulfur, nitrogen, oxygen and metallic elements are usually present in small but often important quantities.

Many metallic elements are found in petroleum. Among the most common metallic elements are arsenic, copper, iron, nickel, lead, vanadium and mercury. Mercury has been known to be a trace contaminant in natural gas and condensate in the Gulf of Thailand since 1985. Mercury found in natural gas is mostly in elemental form and its concentration varies from 10 to 25 mg/m^3. Mercury found in condensate is mostly present in colloidal form and slightly present in other forms: elemental, ionic and organometallic. The concentration range of total mercury in condensate are generally 500 to 800 mg/L (Pongsiri, 1999). Although only limited amounts of data are presently available, it appears that the distribution of mercury compounds in samples varies widely. The types of mercury compounds found in liquid hydrocarbon depend on the sample source (Wilhelm, 1998).

Although mercury is found in trace quantity, it is essential to eliminate mercury from plant products because they are used as feeds to numerous types of chemical manufacturing plants where mercury has a pronounce negative impact on equipment and catalysts. Catalysts used in catalytic processes such as catalytic hydrogenation that is susceptible to mercury poisoning (Sokol' skii, 1983). In addition, mercury can also be a major concerning in liquefied natural gas plants. Mercury-induced corrosion on aluminum heat exchangers has resulted in industrial plants shutdown (Wilhelm, 1998). The next important problem is healthy and safety risk. When mercury contaminated fuel is released into atmosphere along with an exhaust gas after combustion, it can affect human and animal lives. Furthermore, it is necessary to remove mercury in liquid hydrocarbons or reduce to very low level.

Several methods have been proposed for mercury removal from both gas and liquid hydrocarbons. It can be classified into two groups: chemical treatment and adsorption. Refer to chemical treatment, mercury reacts with some chemical substances and transforms to some form of mercury compounds that is easily removed from the hydrocarbon feedstock by simple methods like precipitation and filtration. Unfortunately, this method is required accurate quantities of chemical substances or else the chemical substances can be contaminants in liquid hydrocarbons. In case of adsorption, it is one advanced method for mercury removal. This method comprises of contacting hydrocarbons containing trace amount of mercury with an adsorbent. The adsorption is more preferable because of its high efficiency and effective for mercury removal.

Tantichaipakorn (1998) studied the removal of mercury compounds by adsorption on Ni-Cu adsorbent. The experiments were conducted at 30^{o}C to 70^{o}C and ambient pressure. Mercuric chloride was used as mercury compounds in ionic form. Diphenylmercury used as mercury compounds in organometallic forms. The results showed that removal of mercury was significantly dependent of temperature. In addition, it was also depended on the nature of mercury compounds types. It is referred from the study that two of the factors which can affect the process for mercury removal from liquid hydrocarbon are the chemical nature of each types of mercury compounds and the type of metal species supported on the adsorbent.

The objectives of this research are to study the role of transition metal oxide adsorbents on removal of mercury compounds, and to determine the effect of temperature on removal of mercury compounds.

Adsorbent used for adsorption of mercury compound from liquid hydrocarbon usually has metal as active species on support's surface. The study reported by McNamara conducts the role of metal among group of titanium, stannous, copper, silver, zinc, gold and chromium (McNamara, 1994). It is mentioned that the study is concerned with the activity of adsorbents, which is related to the species of metal supported adsorbent.

Furthermore, many reports indicate that mercury compounds can be adsorbed on a reactor wall produced from stainless steel (Yan, 1991 and Soontaranuruk, 1998). Consequently, it is reported that stainless steel composes of metal species in-group of iron, chromium, nickel, molybdenum and manganese. Refer to the literature review, it is indicated that said metals could be used as an active species supported on adsorbents.

The main purpose of the present investigation is to study the role of adsorbents on removal of ionic and organic forms of mercury. Accordingly, this research is conducted to the adsorption of mercury compounds. Each adsorbent used is prepared by impregnation on silica support, supplied by Carlo erba, with a solution such as nickel nitrate, chromium nitrate, ammoniummolybdate tetrahydrate, ferric nitrate and manganese nitrate. Mercuric chloride and diphenylmercury are used as mercury compounds in experiments. Toluene is used as liquid hydrocarbon solvent because of its reasonable cost and suitable solubility for both mercury compounds.

Liquid feed and product in each experiment are digested with strong acid and are oxidized with permanganate and persulfate solution in case of transforming mercury compound to mercury ion. Quantity of mercury ion is detected by using cold vapor technique atomic absorption spectroscopy. Fresh adsorbents are digested in order to determine content of metal loaded on each adsorbent. Spent adsorbents are digested in order to determine content of mercury contain on each adsorbent. Micromeritics ASAP 2000 is used to analyze total surface area and total pore volume of each fresh and spent adsorbent to compare surface changed after the experiment.