CHAPTER I
INTRODUCTION

Nowadays, people around the world have expressed increasing concern about environmental problems, especially air pollution. SO_x is the one of main gaseous pollutants which is mainly produced from combustion of organic sulfur compounds in transportation fuel. SO_x can cause corrosive to engine, reactor or piping, and it results in acid rain. Therefore the reduction of SO_x must be carried out or sulfur compounds in the transportation fuel must be removed. In recent years, there are many worldwide environmental mandates that primarily focus on the new regulations for production of sulfur in gasoline and diesel (Yang, 2003). In 1998, the European Union first mandated new sulfur specification for drastically reduced levels that started to be phased in from the year 2000 (Hernandez-Maldonado *et al.*, 2005). Currently the U.S. Environmental Protection Agency (EPA) put forward new requirements that the sulfur content of gasoline must be reduced from the current value of 300 ppm to 30 ppm and that of diesel fuel from 500 ppm to 15 ppm by 2006 (Zhang *et al.*, 2008). Moreover the demand of sulfur less than 0.1 ppm has been growing up due to prevention of catalyst deactivation in reforming process and electrodes in fuel cell applications (Park *et al.*, 2008).

At present, the process that has been widely used to remove organic sulfur compounds in liquid fuel is a conventional hydrodesulfurization (HDS). In the HDS process, organic sulfur compounds are broken down to H_2S by using Co-Mo/Al_2O_3 or Ni-Mo/Al_2O_3 as a catalyst at high temperature (300-340°C) and high pressure (20-100 atm of H_2). This process is highly efficient in removing thiols, sulfides, and disulfides, but less effective for thiophenes and thiophene derivatives. Thus, the organic sulfur compounds that remain in the transportation fuels are mainly thiophene, benzothiophene, dibenzothiophene, and their alkylated derivatives (Yang, 2003). Although the HDS process can reduce the organic sulfur compounds in gasoline to less than 30 ppm, it can not reduce organic sulfur compounds in diesel to less than 15 ppm. In order to remove these sulfur compounds in transportation fuel by HDS process to the EPA's desired levels, this would demand more than three-fold increase in the catalyst volume or reactor size. So it is resulting in enormous high cost of operation of this high temperature and high pressure process (Bhandari *et al.*, 2006). Moreover the conventional HDS process results in a significant reduction of octane number due to the saturation of olefins in naphtha from fluid catalytic cracking which also causes higher hydrogen consumption (Ma *et al.*, 2002). Thus it is desirable to search for a new process that can produce ultra low levels of organic sulfur compounds in transportation fuel.

Besides the HDS process, there are other processes that can use for desulfurization in transportation fuels. One of the promising processes is adsorption because it can be operated at ambient condition and without hydrogen consumption. In addition, it is selective to organic sulfur compounds with high sulfur capacity. A wide variety of sorbents are commonly used for adsorption purposes such as activated carbon, activated alumina and zeolite. (Kim *et al.*, 2006: Takahashi *et al.*, 2002; Hernández-Maldonado *et al.*, 2005).

This research aims to study two adsorbents, activated carbon and alumina for diesel fuel desulfurization. The adsorbents will be impregnated with Ni^{2+} and Cu^{+} and then evaluated for their efficiency in removing model sulfur compounds, dibenzothiophene and 4,6-dimethyldibenzothiophene, in both binary and tertiary systems of dodecane as simulated diesel.