CHAPTER I
INTRODUCTION

At present, sulfur in transportation fuels has been a major environmental concern throughout the world (Bhandari *et al.*, 2006). This is because sulfur compounds in the fuels are converted to SO_x during combustion, which are not only result in acid rain, corrosion, and catalytic poisoning (Kim *et al.*, 2006) but also can be toxic to human health and the environment. Therefore, the several countries have mandated further drastically lowering of sulfur concentration in transportation fuels (Bhandari *et al.*, 2006). European Union first mandated new sulfur specification since year 2000 (Hernandez-Maldonado *et al.*, 2005) and has already mandated the maximum sulfur limit of 10 ppm ("sulfur-free") for diesel fuel for highway and nonroad vehicles that started in 2009 (http://www.dieselnet.com/standards/eu/fuel.php). Also the U.S. Environmental Protection Agency (EPA) set that the sulfur content in 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 which is 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).

The sulfur compounds remain in diesel fuel at sulfur level less than 500 ppm are mostly DBTs, such as 4,6-DMDBT, which have lower reactivity in the HDS process. The lower reactivity of these refractory sulfur compounds are largely attributed to the steric hindrance. It has been reported that for the removal of these sulfur compounds by the HDS process to the desired level would demand more than three-fold increase in the catalyst volume/reactor size resulting in enormously high cost of operation of this high temperature and high pressure process (Bhandari *et al.*, 2006). As a result adsorption has become a promising approach in the ultra-deep desulfurization because of some significant advantages such as ability to reduce the sulfur to less than 1 ppm and can be operated at ambient conditions without using H_2. A crucial issue in a successful adsorption process is to identify and develop a novel adsorbent, which has high adsorptive capacity, high selectivity and good regenerability (Zhou *et al.*, 2009).

This research aimed to study the sulfur adsorption efficiency of Ni^{2+} and Cu^{+} based mesoporous sorbents for the desulfurization of simulated diesel via π-complexation by using breakthrough experiment. As Ni^{2+} and Cu^{+} are known for their π-complexation ability, three adsorbents (activated carbon, macroporous alumina and mesoporous alumina) were impregnated with Ni^{2+} and Cu^{+} via incipient wetness method and then was evaluated their efficiency in removal of model sulfur compounds (dibenzothiophene, DBT) in simulated diesel. In addition, this research studied the effects of metal loading concentration, adsorption temperature and adsorbent granulometry on the sulfur adsorption capacity.