CHAPTER I
INTRODUCTION

To utilize natural gas as a fuel in transportation, natural has to be efficiently stored in a high pressure storage tank. This technique is then call compressed natural gas (CNG). The vehicle that fueled by natural gas is also called natural gas vehicle (NGV). In CNG system, high pressure condition (20-25 MPa) is required to compress natural gas into a cylinder tank. However, even at this high pressure, the energy density of stored natural gas is still about half of a typical gasoline, therefore, the driving range for a vehicle for one filling is also about a half of distance, causing more often for re-fueling. Moreover, due to the requirement of high pressure, the investment for the natural gas fueling station is also high. Therefore the number natural gas station is relatively small. From these reasons, there is usually a long waiting line for re-fueling at the natural gas station.

To contain more natural gas in CNG and minimize the extended line at stations, greater volume storage or higher pressure can be applied into the system but for both ways, it have to change some parts or whole instruments to make it work. Nowadays the new developed technology adding adsorption material into gas container is another possible way to increase capacity in the storage tank. These materials provide high surface area for adsorbing gas molecules. Activated carbon, carbon nanotube, molecular sieve and MOFs are examples of adsorption agent that have been developed and studied. Even more and more researches have been done experimentally and confirmed about this principle and also moved forward to ANG (Adsorbed Natural Gas) technology which can make CNG system to operate at much lower pressure than non-adsorption system (new discovered adsorption agent can make storage can operate under pressure downed to 4MPa), there are no adsorption agent system used for vehicle storage in Thailand.

Among adsorption materials, activated carbon is the ordinary agent and can easily be made of inexpensive typical carbonaceous material such as coconut shell (Marcos *et al.*, 2007; Wan *et al.*, 2003; Wei *et al.*, 2008), corn cob (Abdel-Nasser *et al.*, 2000) and coal (Gong *et al.*, 2009; Li-Yeh *et al.*, 1999; Jian *et al.*, 1996;); or complex one like polymer (Laura *et al.*, 2010). They are subjected to either chemical

impregnation followed by heating (called chemical activation), or to be pyrolysed first to carbon and then subjected to steam treatment (called physical activation). As such they have an extremely high surface area (up to 2500 m^2/g) and pore sizes as small as 2 nanometres. The unique characteristics and distinct structure of activated carbon is depended on the preparation process and also starting material. Therefore doing this experiment under high pressure, the activated carbon is selected.

In this work, indigenous source activated carbons from C. Gigantic Carbon Co., Ltd. have been using for natural gas storage materials. Activated carbon sample were pretreated (1) by soaking into acid/base solution to remove trace metal and to increase their surface area (2) by mixing with hydrocarbon to increase the hydrophobicity to increase methane adsorption capacity. The experiment operates under pressure up to 700 psi using non-treating and treating activated carbons as an adsorbent. The methane adsorption capacity will be investigated.