CHAPTER I
INTRODUCTION

Natural gas, the cleanest fossil fuel which consists mainly of methane, is currently used in transportation in Thailand. Consumption of the natural gas as a fuel for vehicle is rapidly increased. Using natural gas as a fuel, storage method must be safe and effective. There are three different storage methods including Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), and Adsorbed Natural Gas (ANG). In Thailand, CNG is widely used for the natural gas storage by compressing and storing under high pressure over 3,600 psi.

However, energy density of compressed natural gas is relatively low comparing to other liquid fuels. Energy density of CNG is approximately one-third of gasoline (11 MJ/L for compressed natural gas at 3,600 psi compared with 32 MJ/L for gasoline) (Burchell *et al.*, 2000).

One of the most common problems found in CNG is low energy density thus a vehicle requires re-filling more often at service station. CNG requires high pressure condition thus the investment for both tank storage and refilling station are high. To increase the travel distance per fill up, the storage capacity needs to be enhanced. It has been suggested that a porous material such as activated carbon can adsorb natural gas due to high surface areas and high porosity, and thus, increase the capacity of natural gas storage.

Several techniques have been developed for methane storage in porous materials such as activated carbons. Many researchers have shown their progress in using adsorbents – activated carbons prepared from oil palm shell (Arami-Niya *et al.*, 2011), coconut shell (Azevedo *et al.*, 2007), rice husk (Balathanigaimani *et al.*, 2006), coffee husk (Giraldo *et al.*, 2011), corn cob (Tsai *et al.*, 2001), eucalyptus, bituminous coal (Qada *et al.*, 2006), MOF-5 (Jia *et al.*, 2011), and macadamia nut shell (Tam *et al.*, 1999). The measurement of pure methane gas adsorption was carried out by both gravimetric (Dreisbach *et al.*, 1999) and volumetric method (Salehi *et al.*, 2007). The result indicated that the physical characteristics of activated carbons such as BET surface area, micropore volume, packing density and pore size distribution are important parameters for the methane uptake (Salehi *et al.*, 2007,

Lozano *et al.*, 2002). In addition, increasing in pressure and decreasing in temperature can increase the amount of methane uptake (Delaver *et al.*, 2010).

The purpose of this research is to study the methane adsorption using several types of commercial activated carbon, such as activated carbons derived from coconut shell, palm shell, and bituminous coal with different iodine number; and coconut-based activated carbon by chemical activation process. Methane adsorption is measured by volumetric apparatus under the pressure up to 1,000 psia and the temperature at 35, 40 and 45 °C. In addition, the physical properties of the activated carbons are characterized by Brunauer, Emmett and Teller (BET) surface analysis, and Field Emission Scanning Electron Microscope (FE-SEM).