CHAPTER I
INTRODUCTION

Global warming is the most important problem in this century. Greenhouse gases, especially CO_2, are the cause of global warming. Today, the main source of CO_2 production is from fossil fuel combustion, more specifically, from power plants (epa.gov; Sayari *et al.*, 2011). In order to reduce CO_2 emission, there are several ways such as switching to clean fuels. At present, these technologies are not ready to substitute the current conventional fuel usage. CO_2 capture is the mid-term solution for reducing CO_2 emission.

CO_2 capture is a strategy to reduce CO_2 emission. One of CO_2 capture routes is the post-combustion capture due to not much modification on the process (Lee *et al.*, 2012). The CO_2 capture technologies are absorption, adsorption, membrane separation, and cryogenic separation. Absorption is generally used in natural gas processing industry due to high capacity when CO_2 concentration is low. But the drawbacks of this process are high energy consumption and corrosive problems (Gupta *et al.*, 2003; GCEP, 2005; Wang *et al.*, 2011). Techniques that are more economical are required. Adsorption is one of cost-effective techniques due to low energy cost and non-corrosive problem (Gupta *et al.*, 2003; GCEP, 2005).

There are several adsorbents used in an adsorption process, such as activated carbons, carbon nanotubes, carbon gels, silicas, zeolites, AlPOs, SAPOs, MOFs, and hydrotalcites etc. (Sayari *et al.*, 2011; Wang *et al.*, 2011). But these adsorbents have limitation of their own. To overcome the limitation, the amine-functionalized adsorbents have been investigated. The idea of amine-adsorbents is the combination of adsorption and absorption. Types of amine-functionalized adsorbents are amine-grafted materials (Hiyoshi *et al.*, 2005; Linfang *et al.*, 2007; Zelenak *et al.*, 2008; Chang *et al.*, 2009; Ko *et al.*, 2011) and amine-impregnated material (Sayari *et al.*, 2011; Xu *et al.*, 2009; Khalil *et al.*, 2012).

Polyethyleneimine (PEI) is a very attractive polymer in CO_2 adsorption fields due to its high affinity with CO_2. Because of different amines and large amount of amines, PEI can adsorb CO_2 via different mechanisms and synergize to enhance CO_2 adsorption performance. The PEI-impregnated materials were investigated (Xu *et al.*, 2003; Xu *et al.*, 2005; Son *et al.*, 2008; Ma *et al.*, 2009; Sanz *et al.*, 2010; Heydari-Gorji and Sayari, 2011; Goeppert *et al.*, 2011; Sharma *et al.*, 2012; Gargiulo *et al.*, 2012). From the reaction of amines with CO_2, the presence of water in the feed was reported to enhance the CO_2 adsorption capacities (Xu *et al.*, 2005; Son *et al.*, 2008; Ma *et al.*, 2009).

Activated carbon is a good support material due to its low-cost, high surface area, and adsorption capacities (Plaza *et al.*, 2010). Pipatsantipong (2011) investigated the use of PEI-impreganated activated carbons for CO_2 adsorption. At 30°C, the addition of PEI did not enhance the capacity. But further increase in the adsorption temperature, the chemisorption played a more significant role than the physisorption. The optimum PEI loading for CO_2 adsorption at 75°C was 0.28% loading.

In this work, further development on the surface functionalization on activated carbon, PEI-impregnated activated carbon, was carried out. Effects of adsorption temperature, molecular weight of PEI, and loading of PEI were investigated to find the optimum condition for CO_2 adsorption.