CHAPTER I
INTRODUCTION

Global energy consumption is rapidly increasing as a result of growing in population, cultivation and industrialization. Therefore, these caused abundant greenhouse gas emissions, especially carbon dioxide emissions. In the present, there are many promising technologies for capturing large amounts of carbon dioxide (CO_2) produced by industry. Main technologies for capturing CO_2 from post-combustion are the absorption by chemical and physical solvents, cryogenic separation and membrane separation. For all of these technologies, gas absorption by chemical solvents such as aqueous solution of alkanolamines is one of most well-known and effective methods (Afshin et al., 2011). However, capturing CO_2 by using aqueous solution of alkanolamines have some drawbacks such as high re-boiler heat duty in the regeneration section, high degradation/evaporation, low gas loadings and severe corrosion (Muhammad et al., 2011). These make this process unattractive for large scale operation. Compared to MEA, aqueous ammonia has advantages of high CO_2 loading capacity, no absorbent degradation and low temperature in regeneration section (85-95 °C) where low-grade thermal energy can be supplied. Moreover, aqueous ammonia has the potential to capture CO_2, SO_2 and NO_x in the flue gas simultaneously. However, an ammonia abatement process is necessary for aqueous ammonia process due to its high volatility at ambient conditions.

Nowadays, a new kind of solvent, ionic liquids (ILs) has been shown to be effective green absorbents for CO_2 capture. Furthermore, ILs have some superior properties that most of alkanolamines do not have such as high selectivity, high thermal and chemical stabilities, almost no vapor pressure, wide range temperature as liquids, tunability and low corrosion (Jian-Gang *et al.*, 2013). One of the most promising ionic liquids in the literature review is 1-ethyl-3-methylimidazolium acetate (EmimAc). It has a very low Henry's law constants of 8.33 bar compared with other ionic liquids (Jessica *et al.*, 2012). Unfortunately, ionic liquids have a high viscosity which represented a serious challenge for industry (Moioli *et al.*, 2012).

Consequently, MEA, aqueous ammonia, and ionic liquid can be used to capture large amounts of CO_2. For each system, the advantages and disadvantages must be investigated and carried out to find the optimal one. In addition, both energy requirement and investment cost of each process would be good indicators to determine the feasibility of the process.

This study is focused on th simulation of CO_2 capture from post-combustion with absorbents, aqueous MEA, ammonia and an ionic liquid 1-Ethyl-3-Methylimidazolium Acetate (EmimAc). The simulation study used the process simulation program Aspen Plus. The flow sheet of MEA, aqueous ammonia, and EmimAc were developed. Then a process heat integration by heat exchanger network (HEN) was designed based on a stage-wise model using mathematical programming software; General Algebraic Modelling System (GAMS). The model was used to optimize the energy requirement of heaters and coolers of the process. Eventually, a comparison of the energy requirement and investment cost among the absorbents was initiated in order to find the optimal designed process.