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SIMULATION TO IMPROVE CO_2 CAPTURE USING VAPOR RECOMPRESSION COMBINED WITH SPLIT-STREAM PROCESS

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July 2017

ABSTRACT

In this era of globalization, carbon dioxide (CO_2) has become one of the main component of greenhouse gases emitted into the atmosphere. Large quantities of CO_2 is released through power generation from fossil fuel-fired power plants. Due to this problem, CO_2 capture technologies have been developed which it is one of the techniques that could be used to reduce CO_2 emissions from human activities. The most well-known technology for post combustion CO_2 capture from exhaust gas is absorption in amine-based solvent followed by desorption. The solvent used in this absorption process is monoethanolamine (MEA). However, this method encountered drawback such as low performance of CO_2 capture efficiency. The objective of this study is to improve CO_2 capture using vapor recompression combined with split-stream process and study the parameters that affect CO_2 capture. Simulation using Aspen HYSYS version 8.8 was used in this study. The fluid package used was Amine Property Package (acid gas). The inlet temperature and pressure at the absorber and concentration of MEA were varied to investigate the effect on CO_2 capture. The result shows that the CO_2 removal efficiency increases as the inlet temperature and concentration of MEA increases. However, the increment was small which only gave small effect on percentage of CO_2 removal. In contrast with inlet pressure at the absorber, CO_2 removal efficiency was highly dependent on the pressure and gave high impact on percentage of CO_2 removal. The best operating condition obtained from this study was at 80 ^{o}C, 400 kpa and 0.14 wt% MEA concentration.

Keywords: carbon dioxide (CO_2), post-combustion, split stream, monoethanolamine (MEA), Aspen HYSYS.

ACKNOWLEDGEMENT

In the name of Allah, the Most Gracious and the Most Merciful. Alhamdulillah, all praises to Allah for the strengths and His blessing in completing this thesis. Special appreciation goes to my supervisor, Prof Madya Ruzitah Mohd Salleh for her supervisions and constant support. Her helps of constructive comments and suggestions throughout this thesis work have contributed to the success of this research. I would like to express my appreciation to all lecturers, staffs and technicians of Chemical Engineering Faculty of UiTM Shah Alam for their help. Sincere thanks to my friends for their help and support during my research. My deepest gratitude goes to my family for their loves, prayers and encouragement. Last but not least, I am forever grateful towards Allah S.W.T for giving me strength and patience for completing this research. Without all the supports I have received, this research project would not have been the same presented here. So, thank you so much.

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INTRODUCTION

1.1 RESEARCH BACKGROUND

One of the elements that can be found all over the world including in every living thing is carbon. Carbon will bond together with oxygen in the air and produce a colorless, odorless gas called carbon dioxide. It is an important trace gas in earth's atmosphere currently constituting about 0.04% (Eggleton & Eggleton, 2013). The emission of carbon dioxide is mostly come from burning of fossil fuels, vehicles, process industries and others. Due to the emission of excessive carbon dioxide, it has become one of the main greenhouse gases that are leading to dramatic changes in global warming and also climate change.

Besides that, CO_2 also is the major contributor to the global warming phenomena due to its abundance comparing to other greenhouse gases, as the results, it is considered to be a primary target for reduction. According to Aaron & Tsouris (2005), the industry accounts for almost 40% of worldwide CO_2 emissions, which is an important point of concern nowadays. Due to this problem, for the better environment and ecosystem, most of the people have started to create a CO_2 capture technologies and several of these technologies have been proposed. It is the process of capturing waste carbon dioxide CO_2 from large point sources and the aim is to prevent the release of large quantities of CO_2 into the atmosphere.

There a several strategies that being considered in order to reduce the CO_2 emissions such as post-combustion capture, pre-combustion capture, oxyfuel combustion and also electrochemical separation. In this case, post-combustion capture is considered the most straightforward schema for application in existing processes, even though it is one of the most challenging approaches due to the diluted concentration of CO_2 and its condition of low pressure in the flue gas. One of the methods that are well-known for post-combustion CO_2 capture from exhaust gas is chemical absorption of CO_2 in an