UNIVERSITI TEKNOLOGI MARA

CO_2 REMOVAL USING IMMOBILIZED CARBONIC ANHYDRASE ON AMBERLITE

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ABSTRACT

Due to rapid emission of CO_2 gas in atmosphere, an approach has to be made to solve this issue. This paper proposed an approach which known as immobilization of carbonic anhydrase (CA) on amberlite for CO_2 removal. CA has been immobilized on amberlite by cross-linking method using glutaraldehyde. CA immobilized on amberlite was further tested in application of carbonation reaction which involved conversion of CO_2 to $CaCO_3$. It was observed that the optimum time for hydration process in carbonation reaction using immobilized CA was 10 min as compared to blank sample (15 min). The optimum mass of immobilized CA on the $CaCO_3$ precipitation was 0.4 g. The carbonate was characterized using XRD and FESEM to validate the formation of $CaCO_3$. FTIR instrument was used to determine the functional group (NH_3) present in immobilized CA enzyme structure. In conclusion, immobilized CA on amberlite support by cross-linking method could be an effective and economical in the practical conversion system of CO_2.

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CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

Carbon dioxide is being one of the major sources that contribute to the world global warming. It is basically coming from the uncontrolled emission of greenhouse gases since the beginning of industrial revolution. Due to the increasing of CO_2 in atmosphere, many researchers are working to solve the current issues related with CO_2 emissions. From the research that had been done, various technologies can be applied in capturing process of CO_2 including absorption, adsorption and membranes. It is reported that solvent based chemical absorption process is the most mature technology for capturing CO_2 (Zhang, Zhang, Lu, Rostam-Abadi, & Jones, 2011). Solvent absorption involves the use of liquid sorbent such as monoethanolamine (MEA) to separate CO_2 from flue gases, while for adsorption, solid sorbent is used instead of liquid sorbent for the separation of CO_2. Membrane separation is a novel technology used to separate CO_2 as it is the best choice and is very economical compared to other separation method (Sreedhar, Vaidhiswaran, Kamani, & Venugopal, 2017).

In order to enhance the mass transfer rate of CO_2 capturing, an addition of carbonic anhydrase (CA) is becoming the most effective enzyme used in this reaction (Lv, Yang, Pan, Zhou, & Jing, 2015). The characteristic of CA itself is that it is reusable and can be used up to a certain maximum repetition. This in turn can reduce the cost for the process and it is one of the important parameters that should be considered. Other than that, researchers had also find out that CA is the fastest zinc metalloenzyme which resulted in rapid motion of CO_2 mass transfer rate from gaseous phase (Zhu, Li, Sun, Tang, & Bian, 2016). The turnover rate of a reaction with CA enzyme can be as great as $10^6 s^{-1}$ compared to the reaction without CA enzyme which is $6.2 \times 10^{-3} s^{-1}$ (Zhang et al., 2011)

The uses of free CA enzyme are also can be considerable in a reaction. When free CA enzyme is added and dissolved into a solution, it may offer a greater specific