UNIVERSITI TEKNOLOGI MARA

MODELLING ON ADSORPTION OF HYDROGEN SULFIDE (H_2S) GAS BY USING HYDROGEL BIOCHAR

AZURA BINTI AZMI

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ABSTRACT

H_2S gas is a toxic, corrosive, colourless and flammable gas that need a great concern on safety when handling with this gas. Thus, the industry that produce H2S gas require a unit operation include adsorption unit process on treating H2S gas. Biochar is a type of adsorbent used to adsorb H2S gas. It is a safe and economical adsorbent compared to activated carbon. Hydrogel been merge with biochar to provide high capability on adsorption of H2S gas. Hydrogel defines as water-swollen substances. Adsorption model is used to determine the efficiency removal of adsorbent. The purpose of modeling an experimental adsorption is to determine the performance of an adsorption which is crucial to optimize for the adsorption mechanism pathway, effective adsorption design system and express on the adsorbent capacity. The process of adsorption modelling is based on Langmuir and Freundlich isotherm model. These type of isotherm model been used in this research study as the model tend to suit the adsorption of solid-gas phase beside can determine the interaction of adsorbate and adsorbent. Based on different flow rate factor that affect the adsoprtion process, value of R^2 obtained from Langmuir model is 0.9902 while R^2 for Freundlich is 0.9601 at flow rate of 60L/h with constant bed height of 6 inch. Meanwhile for factor of different adsorbent bed height, value of R^2 from Langmuir isotherm model is 0.990 while R^2 for Freundlich is 0.960 at adsorbent bed height of 6 inch with constant H_2S gas flow rate at 6 L/h. Thus, the experimental results show that Langmuir model is the most suitable model to be used in the adsorption process as it has the highest correlation coefficient, R^2 compared to Freundlich isotherm model. Besides, the optimum parameter that can be used to optimize the adsorption process of H_2S by using hydrogel biochar is at H_2S gas flow rate of 60 L/h and adsorbent bed height of 6 inc. Lower the flow rate and high bed heigh tend to provide high capacity of adsorption.

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CHAPTER 1 : INTRODUCTION

1.1 Research Background

Discharged of harmful gases to the atmosphere can cause air pollution and acid rain where such gas contain the hydrogen sulphide, H_2S substances. H_2S is a chemical hazard gas commonly found in oil and gas refinery industry, waste water treatment unit process, coal gasification unit prcoess, and other processes. It is also naturally been found in natural gas and crude oil content. H_2S can be known as sour gas and sweet gas depends on the sulfur content. Sour gas indicates to the higher sulfur content vice versa to sweet gas. In low concentration of H_2S, present of H_2S can be detected by its odor smell similar to the rotten egg smell. The gas tend to become odourless when it is in high concentration. Therefore, H_2S gas detector is strictly required to be equipped by the workers working under the present of H_2S in an industry. H_2S is a flammable toxic gases that can affect to human health. It is also corrosive to the metal equipment of unit process in industry. H_2S gas needed to be removed before undergo further unit processing to prevent the equipment from damaged and corrode.

There are many process units can be used to remove the H_2S content in gas such as Claus process, dry scrubber, amine treating and other processes. Adsorption process shows a promising technology to removed the H_2S. It is a flexible process with high efficiency on the removal of H_2S contaminant without producing an unessential byproduct. The adsorption process can be considered as an economical process where the adsorbent can be regenerate and recycled back. Activated carbon is the common type of adsorbent been used in H_2S adsorption. In new era of rapidly developing technology, some researches been done to replace activated carbon with a more cheaper remediation technology and environmental friendly type of adsorbent such as biochar.

Biochar is chosen for the adsorption of H_2S due to its high availability in biomass source. The adsorption can further enhance by mixing the biochar with hydrogel which produce a hydrogel biochar. Hydrogel is a three-dimetional polymer networks