

THE ADDITION EFFECT OF NaOH AND KOH TOWARD BIOGAS PURIFICATION

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ABSTRACT

Biogas is a gas produced by the decomposition of organic materials involving microorganisms in the anaerobic state. The research focused on obtaining good quality biogas through NaOH and KOH purification by reducing H₂S and CO₂ levels. The purification of biogas proceeded in a variation of absorbent concentrations 0,05M, 0,1M, 0,15M NaOH and KOH solution. Gas chromatography chose for biogas characterization. Based on the TCD detector in gas chromatography, it represented concentration area in percentage (%). The content of biogas for control was 2.14% CO₂ and 0% H₂S. The Addition of 0,05; 0,1M; 0,15M NaOH produced 1,57%, 1,56% and 2,98% CO₂ respectively. Moreover, the addition of 0,05 M; 0,1M; 0,15M KOH yielded 0,81%, 0,30% and 1,03% CO₂. The highest of the burning calories was the NaOH 0,15M amount of 66,528 kcal. The lowest of the burning calories was the 0,1M KOH amount of 38,976 kcal.

Keywords: Biogas; Purification; NaOH; KOH

Introduction

The abundance of consumption and the lack of energy sources availability cause the recent global energy crisis. Energy is a significant need in human life especially for transport, household needs, information. Most of the energy product come from fossil energy which produces petroleum and natural gas. Fossil energy sources are increasingly rare and non-renewable. So that it needs alternative energy that can replace it.

Renewable energy sources are a source of environmentally friendly energy that does not pollute the environment. Biogas is one of alternative energy which is now being developed. Biogas is a gas that produced through biological processes. The principle of making biogas is preserving a substrate in the form of human or animal feces into digester unit then isolate it in a chamber. For some time it will form a gas as a product of energy source.¹

The biogas consist of methane gas (55-75%), carbon dioxide (25-45%), nitrogen (0-

0,3%), hydrogen (1-5%), hydrogen sulfide 0-3%), oxygen (0,1-0,5%)². Methane gas is an essential biogas product as the effect of the heat value. The presence of carbon dioxide gas in the fuel can decrease the heat value³. Hydrogen sulfide is gas polluter in commercial gas and the natural gas characterized by odor and highly corrosive for various metals⁴. To increase the value of biogas heat, the levels of methane gas from biomass should be increased by minimalizing the carbon dioxide and hydrogen sulfide level.

Stages of the formation of biogas from anthe aerobic fermentation process are divided into three stages as follows:

1. Hydrolysis (the dissolving stage). The reaction that occurs is:

$$(C_6H_{10}O_5)_n(s) + nH_2O(l) \rightarrow nC_6H_{12}O_6$$
2. Acidogenic (the stage of acidification). The reaction that occurs is:

$$n(C_6H_{12}O_6) \rightarrow 2n(C_2H_5OH) + 2nCO_{2(g)}$$
3. Metagonic (stage of the formation of methane gas). The reaction that occurs is:

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Factors affecting the process of the formation of biogas is anaerobic conditions, stuffing, raw material carbon/nitrogen, the degree of acidity (pH), temperature, starter⁶. Purification process can conduct in various purification methods, for example using water scrubbing, chemical absorption, MEA (Monoethanolamine) and DEA (Diethanolamine), PSA (Pressure Swing Adsorption) and cryogenic separation⁷.

Sasongko⁸ observed the influence of carbon dioxide toward the burning diffusion of biogas. It obtained that the different CO₂ concentrations in percentage did not provide a significant impact on the combustion area. However, the presence of CO₂ in biogas showed its correlation with the flame strength visualized by the alteration of the flame color. Prayugi⁹ examined the biogas purification using condensation and filtering systems in the different media materials. It concluded that the most effective medium to absorb carbon dioxide.

This investigation aims to determine the effect of NaOH and KOH on biogas content (CO₂ and H₂S) and to study the effect of pressure on combustion results. The benefit of this research is the use of environmentally friendly fuel.

Methods

This research is experimental. The biogas reactor installed in which consists of a tube

of purification, digital scales, biogas bags, 4 meters hose size 5/8 inch. The used material was the NaOH and KOH solution. The samples characterized by using gas chromatography to specify the content of biogas. Further, the value of heat analyzed using boiling water at the different time as the controls.

The filter process carried out using the adsorption method by adding the three different concentrations of NaOH and KOH solution, i.e., 0,05M, 0,01M, and, 0,15M. After going through the biogas filtration system, gas flows into the shelter. Next, the gas samples put into biogas bag, and the value of heat measured.

Result and Discussion

The NaOH and KOH solution used as an adsorbent in the purification process. Using this solution, it is expected that biogas passed through the solution will react with the solution. A gas chromatography test was conducted seven times. It was done on biogas samples without a filter as control and using 3 variations of concentrations and 2 kinds of materials. Samples then examined using the detector TCD (Thermal Conductivity Detector).

The results of the qualitative analysis described in the percentage area (%). The content was detected in the chromatography gas consisting of methane gas, carbon dioxide, hydrogen sulfide and air.

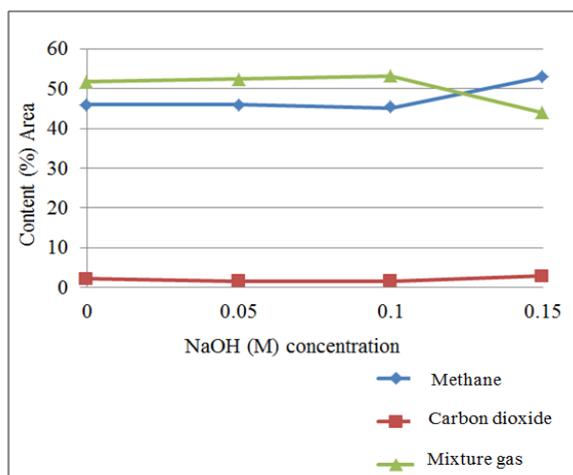


Figure 1. The effect of N ofaOH toward the content area

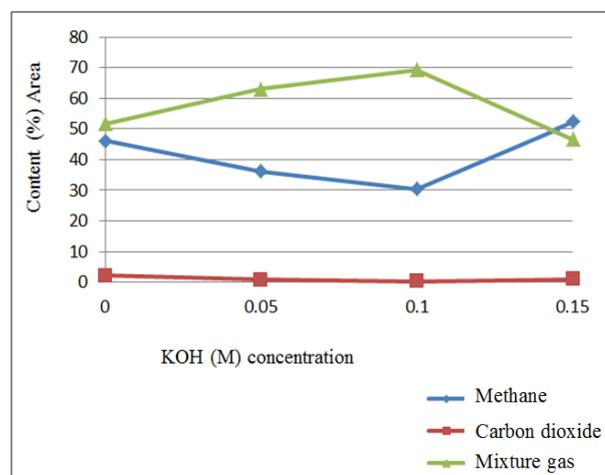
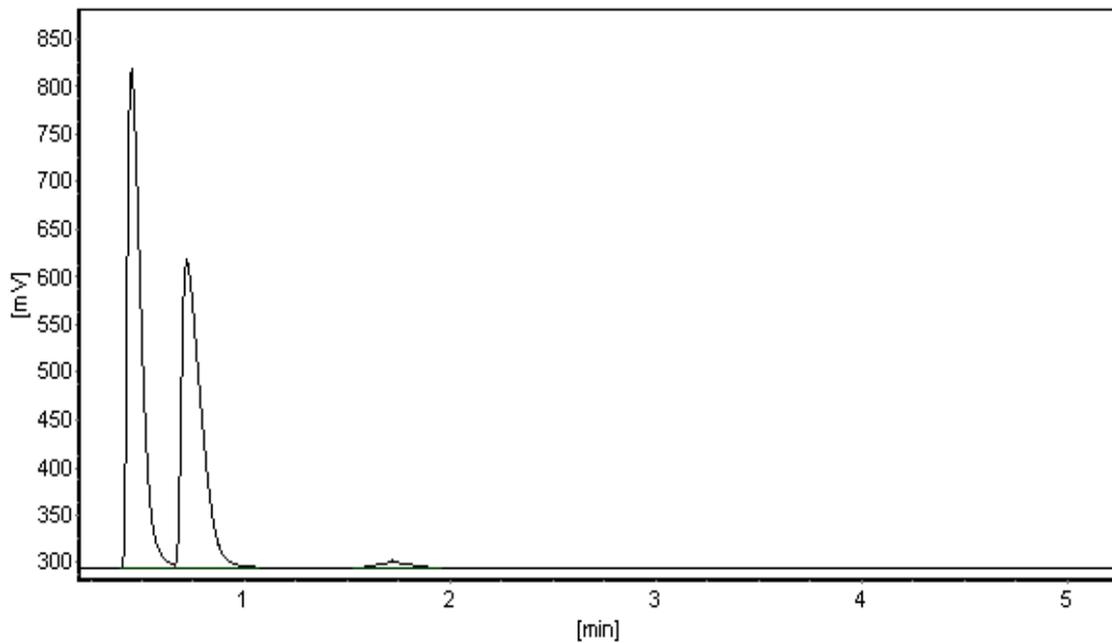


Figure 2. The effect of KOH on biogas

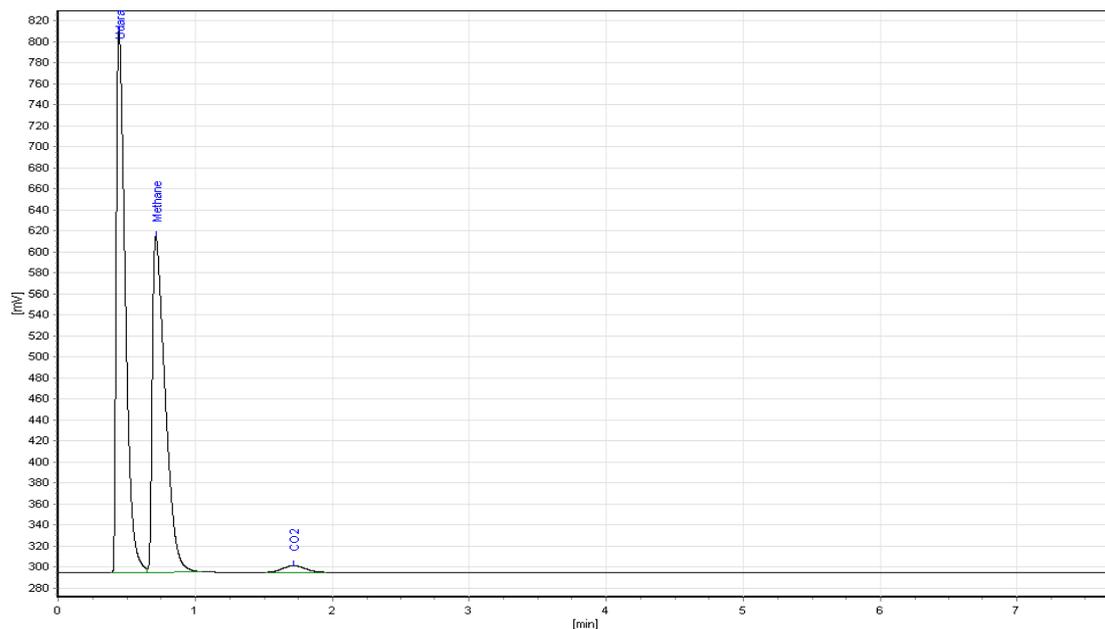
Based on Figure 1, there are three types of gas was detected and analyzed. That are methane, carbon dioxide, and mixture gas. Methane and carbon dioxide concentration was decreased on 0,1 M, but there are was increasing concentration 0,15 M of NaOH. Different from mixture gas concentration which was raised on 0,1 M and then decreases 0,15 M of NaOH

Figure 2. showed that Methane concentration started to decreased on 0,05 M

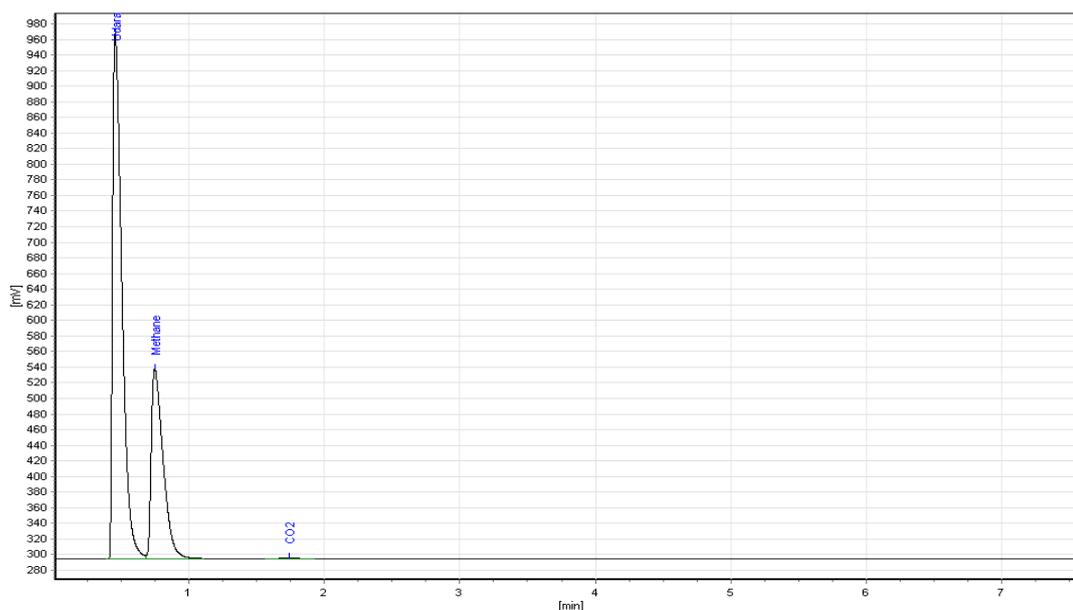
of KOH and more decreased 0,1 M and then increased to 0,15 M of KOH. Almost the same with methane, carbon dioxide also started to decreased on 0,5 M of KOH and increased on 0,15 M of KOH, although the increasing concentration was not as much as methane. Deferent with methane and carbon dioxide, mixture gas started to rise on 0,5 M up to 0, 1 M, but then decreased to 0,15 M of KOH using



Picture 3. Chromatogram biogas detector TCD



Picture 4. Chromatogram biogas treatment NaOH 0,05M



Picture 5. Chromatogram biogas treatment KOH 0,05M

The results formed a Gas Chromatography based on the data in the form of a percentage (%) area. Differences between high and low results in the treatment of each sample show that each sample has different biogas deposits.

Heat value analysis on the NaOH and KOH using as Catalyze in the purification process, heat value leaning to decrease on 0,5 up to 0,1 and increase 0, 15.

The character NaOH and KOH which is classified as a caustic can bind the H₂S and CO₂. Based on the research, both of NaOH and KOH will use full when used in the purification process 0,15 M concentration.

Conclusion

The Purification results which using NaOH and KOH as a catalyst has the highest methane gas content at a concentration of 0.15 M. The lowest carbon dioxide content at a concentration of 0.1 M. The highest mixture gas content at a concentration of 0.1 M. Heat value depend on methane gas and the pressure.

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