

RINGKASAN

Biogas merupakan bahan bakar gas alternatif yang diperoleh dari fermentasi bahan organik. Kualitas biogas sebagai sumber energi ditentukan oleh banyaknya kandungan gas metana (CH_4) yang diperoleh. Kandungan gas metana (CH_4) yang diperoleh semakin tinggi, maka nilai kalor biogas yang dihasilkan akan semakin tinggi. Salah satu upaya peningkatan kualitas biogas dengan cara meningkatkan kandungan gas metana (CH_4) dan menurunkan gas pengotornya ialah dengan pemurnian. Pemurnian biogas dapat dilakukan dengan metode adsorpsi menggunakan dua buah kolom pemurni yang masing-masing diisi dengan adsorben arang aktif dan zeolit. Penelitian ini bertujuan untuk 1) Mengetahui pengaruh laju aliran pada pemurnian biogas menggunakan metode adsorpsi berlapis, 2) Mengetahui pengaruh lama pemurnian pada pemurnian biogas menggunakan metode adsorpsi berlapis, dan 3) Mengetahui hasil pemurnian biogas terbaik dari masing-masing perlakuan laju aliran dan lama pemurnian biogas menggunakan metode adsorpsi berlapis.

Penelitian dilakukan secara eksperimental di Laboratorium Teknik Sistem Termal dan Energi Terbarukan, Fakultas Pertanian, Universitas Jenderal Soedirman. Penelitian dilaksanakan pada bulan Agustus sampai Desember 2020. Variabel penelitian yang diukur pada penelitian ini antara lain rasio C/N, suhu substrat, derajat keasaman (pH), total solid, volatil solid, kandungan gas metana (CH_4), kandungan gas karbon dioksida (CO_2), dan warna api. Rancangan percobaan yang digunakan ialah Rancangan Acak Lengkap (RAL) Non-Faktorial dengan analisis data menggunakan Analisis Ragam (ANOVA) dan Uji Lanjut Duncan's Multiple Range Test (DMRT). Pemurnian biogas menggunakan arang aktif dan zeolit dengan perlakuan laju aliran dan lama pemurnian masing-masing terdiri dari 3 taraf yaitu: 0,1 L/menit, 0,5 L/menit, 1 L/menit dan 10 menit, 20 menit, 30 menit.

Karakteristik pengujian awal substrat kotoran sapi menghasilkan rasio C/N sebesar 19,46% dengan suhu substrat fermentasi rata-rata yaitu 30,23°C dan pH rata-rata 7,3. Total solid (TS) awal dan akhir penelitian mengalami peningkatan sebesar 0,54% dari nilai awal 6,68% menjadi 7,22%. Volatil solid (VS) awal dan akhir penelitian mengalami penurunan sebesar 6,53% dari nilai awal 85,99% menjadi 79,46%. Kandungan gas metana (CH_4) dan karbon dioksida (CO_2) sebelum pemurnian masing-masing ialah 128.375,48 ppm dan 77.752,49 ppm. Hasil penelitian diperoleh bahwa perlakuan laju aliran dan lama pemurnian berpengaruh nyata terhadap kandungan gas yang diperoleh. Kedua perlakuan pemurnian tersebut mampu meningkatkan kandungan gas metana (CH_4) terbaik masing-masing sebesar 82,93% pada laju aliran 1,0 L/menit dan 149,20% pada lama pemurnian 10 menit. Selain itu, mampu menurunkan kandungan gas karbon dioksida (CO_2) masing-masing sebesar 71,90% pada laju aliran 0,1 L/menit dan 80,90% pada lama pemurnian 10 menit.

SUMMARY

Biogas is an alternative gas fuel produced from fermentation of organic matter. The quality of biogas as an energy source is determined by the amount of methane gas (CH_4) that is obtained. When the methane (CH_4) content is higher, so the calorific value of the biogas is also can be higher. One of the methods to improve the quality of biogas by increasing the content of methane gas (CH_4) and reducing its impurity is by purification method. Biogas purification can be carried out by the adsorption method in which using two purifying columns, each of which is filled with activated charcoal and zeolite adsorbent. This study aims to 1) Determine the effect of flow rate on biogas purification using a layered adsorption method, 2) Find out the effect of purification time on biogas purification using a layered adsorption method, and 3) Find out the best biogas purification results from each treatment flow rate and purification time biogas using a layered adsorption method.

The research was carried out by experimental method at the Thermal Systems and Renewable Energy Engineering Laboratory, Faculty of Agriculture, Jenderal Soedirman University. The research was done from August to December 2020. The research variables measured in this study included the C/N ratio, substrate temperature, degree of acidity (pH), total solid, volatile solid, methane gas content (CH_4), carbon dioxide gas content (CO_2), and the color of the fire. The experimental design used was a Non-factorial Completely Randomized Design (CRD) with data analysis using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT). Biogas purification using activated charcoal and zeolit by flow rate treatment and duration of purification treatment each consists of 3 levels, that are: 0.1 L/minute, 0.5 L/minute, 1 L/minute and 10 minutes, 20 minutes, and 30 minutes.

Characteristics of the initial test of cow dung substrate resulted in a C/N ratio of 19.46% with an average fermentation substrate temperature of $30,23^\circ\text{C}$ and an average pH of 7,3. The total solid at the beginning and at the end of the study increased by 0.54% from the initial TS value of 6.68% to 7.22%. The initial and final solid volatiles of the study decreased by 6.53% from the initial VS value of 85.99% to 79.46%. Methane (CH_4) and carbon dioxide (CO_2) content before purification were 128,375.48 ppm and 77,752.49 ppm, respectively. The results showed that the treatment flow rate and purification time had a significant effect on the gas content obtained. The two purification treatments were able to increase the best methane gas (CH_4) content of 82.93% at a flow rate of 1.0 L/minute and 149.20% for 10 minutes of purification time. In addition, it was able to reduce the content of carbon dioxide gas (CO_2) by 71.90% at a flow rate of 0.1 L / minute and 80.90% for 10 minutes of purification.