

ANALISIS KOMBINASI FAKTOR pH, SUHU DAN RASIO BAHAN ORGANIK BERBASIS *SOLID STATE ANAEROBIC DIGESTION* (SS-AD) TERHADAP PRODUKSI BIOGAS DARI LIMBAH TANDAN KOSONG KELAPA SAWIT

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INTISARI

Biogas merupakan produk hasil fermentasi bahan organik dengan bantuan bakteri pada kondisi anaerobik. Biogas dapat dihasilkan dari fermentasi limbah seperti limbah tandan kosong kelapa sawit (TKKS). Limbah TKKS yang dihasilkan oleh Pabrik Kelapa Sawit Kertajaya sebanyak 165.6 ton dalam satu hari belum dimanfaatkan secara baik. Berdasarkan uji laboratorium, limbah TKKS memiliki kandungan organik yaitu *total solid* 88.348%, kadar air 11.652%, lignin 27.26%, selulosa 24.57%, hemiselulosa 30.09%, protein 1.760%, lemak 4.215%, gula reduksi 8.908%, karbon 20.50%, nitrogen 0.276% dan rasio C/N 72.6:1. Penelitian ini memiliki tujuan yaitu mengukur volume biogas berupa gas metana selama 45 hari, mengetahui hubungan dan pengaruh faktor pH, suhu, rasio F/I dan rasio C/N terhadap produksi gas metana, mengetahui hubungan dan pengaruh produksi gas metana terhadap penurunan bahan organik dari limbah TKKS dan lumpur minyak sawit serta mengetahui kombinasi faktor terbaik untuk memproduksi gas metana.

Produksi biogas dari limbah TKKS dilakukan dengan prinsip *solid state anaerobic digestion* (SS-AD) selama 45 hari. Sumber bakteri yang digunakan yaitu berasal dari limbah lumpur minyak sawit dengan TPC sebanyak 6.6×10^6 CFU/ml. Desain eksperimen yang digunakan yaitu Metode Taguchi dengan 4 faktor, 3 level dan dilakukan sebanyak 9 eksperimen dan 3 replikasi. Analisis data yang digunakan yaitu rasio S/N, regresi non linear dan statistik non paramterik.

Produksi biogas tertinggi selama 45 hari terjadi pada eksperimen F sebanyak 1085.574 ml CH₄ atau 3.619 ml CH₄/g TKKS. Produksi gas metana dipengaruhi secara signifikan oleh kombinasi faktor pH, suhu, rasio F/I dan rasio C/N. Penurunan kandungan organik dari limbah TKKS dan limbah lumpur minyak sawit dipengaruhi secara signifikan oleh produksi gas metana selama 45 hari. Kombinasi faktor terbaik untuk memproduksi gas metana yaitu pada eksperimen F dengan kombinasi pH 7, suhu 55°C, F/I 2:1, C/N 30:1 dengan nilai rasio S/N sebesar 60.492.

Kata kunci : Biogas, TKKS, Taguchi

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COMBINATION FACTOR ANALYSIS OF pH, TEMPERATURE AND MATERIAL ORGANIC RATIO BASED ON SOLID STATE ANAEROBIC DIGESTION (SS-AD) ON BIOGAS PRODUCTION FROM OIL PALM EMPTY FRUIT BUNCHES WASTE

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ABSTRACT

Biogas is a product of fermentation of organic matter with the help of bacteria on anaerobic conditions. Biogas can be produced from waste fermentation such as oil palm empty fruit bunches (OPEFB) waste. The OPEFB waste produced by the Kertajaya Palm Oil Mill as much as 165.6 tons in one day has not been utilized properly. Based on laboratory tests, OPEFB waste has an organic content of 88.348% total solids, 11.652% moisture content, 27.26% lignin, 24.57% cellulose, 30.09% hemicellulose, 1.760% protein, 4.215% fat, 8.908% reducing sugar, 20.50% carbon, 20.50% carbon, nitrogen 0.276% and C/N ratio of 72.6: 1. The purpose of this study was to measure the volume of biogas in the form of methane gas for 45 days, to determine the relationship and influence of pH, temperature, F/I ratio and C/N ratio on methane gas production, to know the relationship and influence of methane gas production on organic matter degradation from OPEFB waste and palm oil sludge and know the best combination of factors for producing methane gas.

Biogas production from OPEFB waste was carried out with the principle of solid state anaerobic digestion (SS-AD) for 45 days. The source of bacteria used is derived from palm oil sludge waste with TPC as much as 6.6×10^6 CFU/ml. The experimental design used was the Taguchi Method with 4 factors, 3 levels and 9 experiments and 3 replications were carried out. Data analysis used was the S/N ratio, non linear regression and non parametric statistics.

The highest biogas production for 45 days occurred in the F experiment of 1085,574 ml CH₄ or 3.619 ml CH₄/gOPEFB. Methane gas production is significantly affected by a combination of pH, temperature, F/I ratio and C/N ratio. A decrease in the organic content of OPEFB waste and palm oil sludge waste is significantly affected by 45 days of methane gas production. The best combination of factors for producing methane gas is in experiment F with a combination of pH 7, temperature 55⁰C, F/I 2:1, C/N 30:1 with an S/N ratio of 60.492.

Keywords : Biogas, OPEFB, Taguchi

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