

Life Cycle Assessment (LCA) Biogas Berbahan Baku

Tandan Kosong Kelapa Sawit (TKKS)

INTISARI

Tandan Kosong Kelapa Sawit (TKKS) merupakan limbah padat terbanyak dari industri pengolahan kelapa sawit yang belum termanfaatkan secara optimal. Banyak penelitian yang menguji potensi TKKS salah satunya menjadi substrat biogas, tetapi penelitian mengenai dampak lingkungannya belum dilakukan. Oleh karena itu, analisis *Life Cycle Assessment* (LCA) dilakukan untuk mengetahui dampak lingkungan yang dihasilkan terutama emisi *Global Warming Potential* (GWP). Penelitian ini bertujuan untuk mengidentifikasi dan menentukan jumlah energi, emisi, dan skenario alternatif pengolahan limbah TKKS.

Penelitian ini dimulai dengan percobaan konfirmasi untuk membandingkan hasil biogas berdasarkan referensi yang digunakan, kemudian analisis LCA menggunakan bantuan *Software OpenLCA 1.11.0*, ruang lingkup *cradle to gate*, dan Unit Fungsional (UF) 1-ton TKKS. Data yang di input pada *software* maupun nilai konversi energi dan emisi diperoleh dari berbagai sumber pustaka resmi yaitu jurnal, skripsi/ tesis, *database Agribalyse V301*, dan *Intergovernmental Panel Climate Change* (IPCC). Analisis sensitivitas dan perbandingan dilakukan untuk mengetahui pengolahan limbah yang baik melalui banyak-sedikitnya emisi GWP yang dihasilkan.

Hasil analisis LCA pada *mini plan* pengolahan biogas TKKS dan *Palm Oil Mill Effluent* (POME) sebagai inokulumnya menghasilkan GWP lebih rendah dibandingkan tidak memanfaatkan limbah TKKS sama sekali maupun pemanfaatan TKKS. Pengolahan biogas TKKS metode *Liquid Anaerobic Co-Digester* (L-AD) menghasilkan emisi GWP sebanyak 9,83327 kg CO₂-eq, sedangkan metode *solid Anaerobic Co-Digester* (S-AD) sebanyak 5,12 kg CO₂-eq. Skenario pengolahan biogas TKKS dengan POME dapat menjadi skenario alternatif pengolahan limbah TKKS dalam konteks lingkungan terutama dengan metode S-AD.

Kata kunci: Tandan Kosong Kelapa Sawit, Palm Oil Mill Effluent, Life Cycle Assessment, Global Warming Potential

Life Cycle Assessment (LCA) in the Production of Biogas Made from Oil

Palm Empty Fruit Bunches (EFB)

ABSTRACT

Oil Palm Empty Bunches (EFB) is the most solid waste from the palm oil processing industry that has not been utilized optimally. Many studies have tested the potential of EFB, one of which was to become a biogas substrate, but research on its environmental impact has not been carried out. Therefore, a Life Cycle Assessment (LCA) analysis was carried out to determine the environmental impact produced, especially the Global Warming Potential (GWP) emissions. This study was aimed to identify and determine the amount of energy, emissions, and alternative scenarios for processing EFB waste.

This study began with a confirmation experiment to compare biogas yields based on the references used, then LCA analysis using the help of OpenLCA 1.11.0 Software, cradle to gate as a scope, and Functional Unit (FU) 1-tons of EFB. The input of the data in the software as well as the energy conversion and emission scores were obtained from various official library sources such as journals, theses, Agribalyse V301 database, and the Intergovernmental Panel on Climate Change (IPCC). The sensitivity and comparison analysis were carried out to find out the best waste treatment through the least amount of GWP emissions produced.

The results of LCA analysis on the mini plan for processing EFB biogas and Palm Oil Mill Effluent (POME) as the inoculum resulted in a lower GWP than not utilizing EFB waste at all or utilizing EFB. Processing of EFB biogas using the Liquid Anaerobic Co-Digester (L-AD) method resulted in GWP emissions of 9.83327 kg CO₂-eq, while the Solid Anaerobic Co-Digester (S-AD) method produced 5.12 kg CO₂-eq. The scenario for processing EFB biogas with POME was able to be an alternative scenario for processing EFB waste in the environmental context, especially with the S-AD method.

Keywords: Empty Fruit Bunches, Palm Oil Mill Effluent, Life Cycle Assessment, Global Warming Potential