ABSTRAK

KARAKTERISASI *SYNGAS* HASIL GASIFIKASI LIMBAH KULIT TANDUK KOPI (*COFFEE PARCHMENT*) MENGGUNAKAN *DOWNDRAFT GASIFIER*

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Ketersediaan kopi yang berlimpah di berbagai sektor menyebabkan limbah hasil sisa pengolahannya kian meningkat juga. Salah satu sisa limbah kopi yakni kulit tanduk kopi. Kulit tanduk kopi atau coffee parchment merupakan bagian yang melapisi biji dan mempunyai kandungan karbon cukup banyak yaitu 45,3%. Jumlah karbon yang banyak inilah menjadi salah satu untuk menggunakan metode gasifikasi sebagai solusi pengurangan limbah kulit tanduk kopi. Penelitian in bertujuan untuk menganalisis komposisi gas sintesis (syngas), nilai lower heating value (LHV), serta karakteristik energi dari kulit tanduk kopi (coffee parchment) yang dihasilkan melalui proses gasifikasi menggunakan downdraft gasifier. Analisis syngas dilakukan menggunakan Portable Infrared Syngas Analyzer Gasboard G3100-P untuk menentukan kandungan CO, CO_2, CH_4, H_2, dan O_2. Hasil menunjukkan bahwa rata-rata komposisi syngas yang dihasilkan yaitu CO 4,95%, CO_2 5,81%, CH_4 0,56%, H_2 4,24%, dan O_2 13,19%. Nilai lower heating value rata-rata sebesar kcal/m³ dengan kisaran antara kcal/m³. Hasil analisis proksimat pada biomassa kulit tanduk kopi menunjukkan kadar air 14,85%, zat terbang 11,94%, abu 4,85%, dan karbon terikat 68,36%, sedangkan ash (by-product) memiliki kadar air 26,85%, zat terbang 8,63%, abu 6,81%, dan karbon terikat 57,71%. Hasil proksimat selain kadar air menunjukkan bahwa kulit tanduk kopi merupakan bahan baku yang bagus ketika dibakar, namun hasil syngas yang didominasi oleh oksigen (O_2) menyatakan adanya ketidakstabilan laju udara saat proses gasifikasi sehingga mempengaruhi komponen syngas lainnya.

Kata kunci **:** kulit tanduk kopi, biomassa agroforestri, gasifikasi, downdraft gasifier, syngas

ABSTRACT

CHARACTERIZATION OF SYNGAS PRODUCED FROM GASIFICATION OF COFFEE PARCHMENT WASTE USING DOWNDRAFT GASIFIER

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Coffee-based agroforestry systems generate large quantities of processing residues, one of which is coffee parchment, the protective layer surrounding coffee beans during wet processing. Despite its relatively high carbon content, the utilization of coffee parchment as a renewable energy source remains limited. This study aimed to evaluate the potential of coffee parchment waste as a bioenergy feedstock through gasification by analyzing the syngas composition, lower heating value (LHV), and proximate characteristics of the biomass. Gasification experiments were conducted using a downdraft gasifier reactor with coffee parchment as the primary feedstock. Syngas composition was measured using a Portable Infrared Syngas Analyzer (Gasboard G3100-P) to determine the concentrations of CO, CO_2, CH_4, H_2, and O_2. In addition, proximate analysis was performed to evaluate moisture content, volatile matter, ash content, and fixed carbon of both biomass and gasification solid by-product in the form of biochar. The results showed that the average composition of the syngas composition consisted of 4.95% CO, 5.81% CO_2, 0.56% CH_4, 4.24% H_2, and 13.19% O_2. The lower heating value of the produced syngas ranged from 256.15 to 417.19 kcal/m^3 during the gasification process. Proximate analysis revealed that coffee parchment biomass had an average moisture content of 14.85%, volatile matter of 11.94%, ash content of 4.85%, and fixed carbon of 68.36%. The relatively high fixed carbon content indicates that coffee parchment has promising characteristics as a solid bioenergy feedstock. However, the dominance of oxygen in the syngas composition suggests that airflow conditions in the gasifier were unstable, affecting the quality of the produced gas. Overall, the results demonstrate that coffee parchment waste from agroforestry systems has potential as a renewable energy resource, although

optimization of gasification operating conditions is required to improve syngas quality and energy efficiency.

Keyword**:** coffee parchment, agroforestry biomass, gasification, downdraft gasifier, syngas