ABSTRAK

PENGARUH KONSENTRASI KATALIS BENTONIT TERHADAP TEMPERATUR OPERASI DAN KUALITAS PRODUK SYNGAS PADA ALAT GASIFIER TIPE UPDRAFT

(Muhamad Dikha Adriansyah, 2026 : 66 Halaman, 10 Tabel, 37 Gambar)

Ketergantungan global pada bahan bakar fosil mendorong urgensi pemanfaatan biomassa lokal seperti tempurung kelapa sebagai energi alternatif melalui teknologi gasifikasi. Penelitian ini bertujuan menganalisis pengaruh konsentrasi konsentrasi katalis bentonit terhadap profil temperatur operasi reaktor dan kualitas *syngas* yang dihasilkan. Metode eksperimental dilakukan menggunakan *fixed-bed gasifier* tipe *updraft* berkapasitas 10 kg dengan massa umpan konstan 9 kg arang tempurung kelapa (2 mesh). Katalis bentonit diaktivasi melalui kalsinasi pada suhu 400ºC sebelum dicampurkan dengan konsentrasi katalis bentonit 0%, 5%, 10%, 15%, dan 20%. Hasil penelitian menunjukkan bahwa penambahan bentonit secara signifikan mengubah distribusi termal reaktor. Temperatur zona pembakaran (T_1) paling optimal dicapai pada konsentrasi 15% (972ºC), sedangkan temperatur zona reduksi (T_2) naik linear hingga tertinggi 1122ºC pada konsentrasi 20% akibat peran kandungan Al_2O_3 dan situs asam katalis dalam memecah tar. Penambahan katalis hingga 20% berhasil meningkatkan kualitas *syngas* bersih secara bertahap, ditandai dengan kenaikan gas mampu bakar: H_2 (dari 12,5% menjadi 16,1%), CO (dari 22,8% menjadi 25,2%), dan CH_4 (dari 3,17% menjadi 3,29%). Sebaliknya, gas pengotor CO tertekan hingga 21,4% dan H_2 berkurang drastis menjadi 0,019%. Perbaikan komposisi ini secara langsung mendongkrak kerapatan energi *syngas*, di mana nilai *Lower Heating Value* (LHV) tertinggi dicapai pada konsentrasi bentonit 20% yaitu sebesar 6113,031 KJ/m^3 atau meningkat sebesar 13,67% dibandingkan kondisi tanpa katalis.

Kata Kunci: *Gasifikasi Updraft, Tempurung Kelapa, Katalis Bentonit, Kalsinasi, Syngas, LHV.*

ABSTRACT

Effect of Bentonite Catalyst Concentration on Operating Temperature and Syngas Product Quality in an Updraft Gasifier

(Muhamad Dikha Adriansyah, 2026 : 66 Pages, 10 Tables, 37 Figures)

Global reliance on fossil fuels drives the urgent need to utilize local biomass—such as coconut shells—as an alternative energy source via gasification technology. This study aims to analyze the effect of varying bentonite catalyst concentrations on reactor operating temperature profiles and the quality of the resulting syngas. An experimental approach was employed using a 10 kg capacity updraft fixed-bed gasifier with a constant feedstock mass of 9 kg of coconut shell charcoal (2-mesh size). The bentonite catalyst was activated via calcination at 400ºC before being mixed at concentrations of 0%, 5%, 10%, 15%, and 20%. The results indicate that the addition of bentonite significantly altered the reactor's thermal distribution. The optimal combustion zone temperature (T_1) was achieved at the 15% concentration (972ºC), while the reduction zone temperature (T_2) rose linearly to a peak of 1122ºC at the 20% concentration, driven by the role of Al_2O3 content and the catalyst's acidic sites in tar cracking. Increasing the catalyst concentration up to 20% progressively improved clean syngas quality, evidenced by increases in combustible gas content: H_2 (from 12.5% to 16.1%), CO (from 22.8% to 25.2%), and CH_4 (from 3.17% to 3.29%). Conversely, impurity levels were suppressed, with CO_2 dropping to 21.4% and H_2 decreasing drastically to 0.019%. This compositional improvement directly boosted the syngas energy density; the highest Lower Heating Value (LHV) of 6113.031 kJ/m³ was achieved at the 20% bentonite concentration, representing a 13.67% increase compared to the catalyst-free condition.

Keywords: *Updraft Gasification, Coconut Shell, Bentonite Catalyst, Calcination, Syngas, LHV.*