

# Pemanfaatan Limbah Ampas Tebu, Cangkang Sawit, dan Sekam Padi sebagai Agen Pereduksi Terbarukan = Utilization of Bagasse, Palm Kernel Shell, and Rice Husk Wastes as Renewable Reducing Agents

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## Abstrak

Secara umum penelitian ini bertujuan untuk mengeksplorasi kemungkinan penggunaan limbah biomassa dalam proses *reduction roasting* bijih besi nikel laterite Indonesia. Adapun motif di balik penelitian ini adalah untuk meningkatkan nilai tambah dari bijih besi kadar rendah dan mendapatkan bio-reduktor baru yang akan menjadi alternatif pengganti batu bara di masa depan. Dalam penelitian ini diteliti tiga limbah biomassa sebagai agen pereduksi bijih besi nikel laterite dari Sorowako, yaitu: ampas tebu dari kabupaten Cirebon, cangkang sawit dari Palangkaraya - Kalimantan Tengah, dan sekam padi dari Kerawang - Jawa Barat. Adapun metode yang digunakan adalah *reduction roasting* dengan variasi parameter temperatur, rasio massa, dan waktu reduksi. Selanjutnya dilakukan analisis berdasarkan pola difraksi hasil *X-Ray Diffraction* (XRD), *X-Ray Fluorescence* (XRF), dan *Induced Couple Plasma Mass Spectroscopy* (ICP-MS).

Hasil yang diperoleh dalam penelitian ini menunjukkan bahwa ampas tebu, cangkang sawit, dan sekam padi terbukti mampu digunakan sebagai agen pereduksi alternatif pengganti batu bara. Pada penelitian ini, ampas tebu hanya mampu menghasilkan fasa *wustite* dalam *reduction roasting* bijih besi nikel laterite, di mana hasil reduksi tertinggi diperoleh pada sampel dengan rasio massa 1:4 yang direduksi pada temperatur 1000°C selama 30 menit. Sementara itu, cangkang sawit mampu mereduksi bijih besi nikel laterite menjadi Fe metal, dimana parameter optimalnya adalah: rasio massa = 1:3, durasi waktu reduksi = 30 menit, dan temperatur reduksi 1000°C. Di samping itu, meskipun sekam padi hanya mampu mereduksi bijih besi sampai fasa magnetite (dimana hasil optimal diperoleh pada penambahan padi sebesar 20%), tetapi dari sekam padi berhasil diperoleh bio-silika amorf dengan tingkat kemurnian 99,99% dan *specific surface area* (luas permukaan spesifik) 192 m<sup>2</sup>/g.

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In general, this study aims to explore the utilization of local biomass as renewable reducing agents in the reduction roasting of Indonesian nickel laterite iron ore. The motive behind this research is to increase the added value of low grade iron ore and to obtain reducing agents to substitute coal in the reduction process. In this study, the three of biomass which have potential to be used as reducing agents for coal substitutes in reducing nickel laterite iron ore from Sorowako, are: bagasse from Cirebon, palm shells from Palangkaraya - Central Kalimantan, and rice husk from Kerawang - Jawa Barat. The reduction method used is reduction roasting with various temperature, mass ratio, and reduction time. And the analysis is based on the diffraction pattern of X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), and Induced Couple Plasma Mass Spectroscopy (ICP-MS).

The results obtained in this study indicate that bagasse, palm kernel shells, and rice husks have been proven to be able to be used as an alternative reducing agent for coal substitution. In this study, bagasse was only able to produce the wustite phase in the reduction roasting of nickel laterite iron ore, where the highest reduction results were obtained in samples with a mass ratio of 1: 4 which was reduced at a temperature of

1000°C for 30 minutes. Meanwhile, palm kernel shells could reduce nickel laterite iron ore to Fe metal, where the optimal parameters were: mass ratio = 1: 3, reduction time duration = 30 minutes, and reduction temperature = 1000°C. In addition, although rice husk was only able to reduce iron ore to magnetite phase (where optimal results are obtained by adding rice by 20%), but from rice husk it was successfully obtained amorphous bio-silica with a purity level of 99.99% and specific surface area 192 m<sup>2</sup>/g.