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TRANSFORMING SOLID WASTES INTO HIGH QUALITY BIOENERGY PRODUCTS: ENTROPY ANALYSIS

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ABSTRACT

Although energy analysis of a pyrolysis system improves the thermal efficiency of the process, it did not account for the quality of energy used and produced from the process. This paper presents the entropy of analysis of converting solid wastes into useable bio-products during pyrolysis. The entropy balance was performed on a continuous flow pyrolysis reactor system using pine pellets as a feedstock at the pyrolysis temperature of 773 K. An interesting conclusion was drawn from the results that the pyrolysis process converted low quality and high entropy biomass into high quality and low entropy energy products char, bio-oil, and gases. The analysis concluded that the both pyrolysis and combustion were the process of low entropy production and most part of the irreversibility or positive entropy production was mainly associated with condenser unit. The high quality energy producing pyrolysis process may be included as part of the future biorefinery.

Keywords: Pyrolysis, Bioenergy, Entropy, Solid waste

NOMENCLATURE

f	shape factor
$\overline{h_c}$	heat of combustion (kJ/kmol)
H	enthalpy (kJ/kmol)
HHV	higher heating values (MJ/ kg)
k	thermal conductivity (W/m.K)
L	length of pyrolysis zone (m)
$\dot{m}$	mass flow rate (g/min)
$\dot{Q}$	rate of energy flow (kJ/min)
r	radius (m)
s	specific entropy (kJ/kmol.K)
$\dot{S}$	rate of entropy flow (kJ/min.K)
$\Delta\dot{S}$	rate of entropy change (kJ/min.K)
T	temperature, K

Subscripts and superscripts

a	ambient