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**Utilization of acetone-butanol-ethanol-water mixture obtained from biomass  
fermentation as renewable feedstock for hydrogen production via steam reforming:  
Thermodynamic and energy analyses**

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**Abstract**

A thermodynamic equilibrium analysis on steam reforming process to utilize acetone-butanol-ethanol-water mixture obtained from biomass fermentation as biorenewable fuel has been performed to produce clean energy carrier  $H_2$  via non-stoichiometric approach namely Gibbs free energy minimization method. The effect of process variables such as temperature (573-1473 K), pressure (1-10 atm), and steam/fuel molar feed ratio ( $F_{ABE}=5.5-12$ ) have been investigated on equilibrium compositions of products,  $H_2$ , CO,  $CO_2$ ,  $CH_4$  and solid carbon. The best suitable conditions for maximization of desired product  $H_2$ , suppression of  $CH_4$ , and inhibition of solid carbon are 973 K, 1 atm, steam/fuel molar feed ratio=12. Under these conditions, the maximum molar production of hydrogen is 8.35 with negligible formation of carbon and methane. Furthermore, the energy requirement per mol of  $H_2$  (48.96 kJ), thermal efficiency (69.13%), exergy efficiency (55.09%), exergy destruction (85.36 kJ/mol), and generated entropy (0.29 kJ/mol.K) have been achieved at same operating conditions.

**Keywords:** Hydrogen, steam reforming, energy, exergy, acetone-butanol-ethanol-water mixture.

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