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This is the official journal of the International Association for Hydrogen Energy. It aims to provide a central vehicle for exchange and dissemination of basic ideas in the field of hydrogen energy between research scientists and engineers throughout the world. The emphasis will be placed on original research, both analytical and experimental, of permanent interest to engineers and scientists in various aspects of hydrogen energy, namely production, storage, transmission, utilization, as well as the economical, environmental and international aspects.

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High-yield hydrogen production from glucose by supercritical water gasification without added catalyst

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ABSTRACT

Continuous supercritical water gasification of glucose is investigated with a recently developed updraft gasification apparatus under various conditions: temperatures of 600–767 °C, residence times of 15–60 s, glucose concentrations of 1.8–15 wt% and without added a catalyst. The experimental gas yields are compared with predicted values at equilibrium that are estimated via Gibbs free energy minimization. Total gas yields and hydrogen gas yield increase with temperature. At 740 °C and 1.8 wt%, hydrogen gas yields become very high (10.5–11.2 mol/mol glucose). The hydrogen gas yields do not vary significantly with different residence times. The hydrogen gas yield decreases to 5.7 mol/mol glucose at 15 wt%, a value very close to the predicted value (6.3 mol/mol glucose). Only acetic acid is detected in the liquid effluents at temperatures above 740 °C, while 42 products are detected at 600 °C. The highest hydrogen gas yield obtained in this study is 11.5 mol/mol glucose at 25 MPa, 767 °C, and 1.8 wt%, for 60 s; this value is very close to the theoretical equilibrium hydrogen yield of 11.9 mol/mol glucose. Under these conditions, the carbon efficiency is very high (91%) and total organic carbon (TOC) in the liquid product is very low (23 ppm), indicating that glucose is almost completely converted to gaseous products. Comparison with other work under similar operating conditions shows that the current reactor is capable of attaining higher hydrogen gas yields at temperatures above 650 °C. Possible explanations for the higher hydrogen gas yields are presented.

1. Introduction

Because of the pressing issues of global warming and fossil fuel depletion, the production of alternative energy from renewable sources has received considerable attention. Hydrogen from biomass can be used directly in fuel cells to produce electricity. Biomass is considered a future energy source because it is renewable, abundant, outside of the human food chain, and carbon neutral. Generally, a large proportion of biomass is water (up to 90%), so energy- and

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