

Parametric characterization of air gasification of *Chlorella vulgaris* biomass

ABSTRACT

The gasification of green algae *Chlorella vulgaris* in air was investigated using both a thermogravimetric analyser (TGA) and a bench scale horizontal axis quartz tube reactor (HQR). The full range of solid state kinetic models produced best fits with TGA results varied for the five subzones of conversion vs temperature, with the nucleation and nuclei growth “A2” followed by “A3” or contracting volume models producing close matches for $T \leq 367$ °C, a zero-order model between 358 and 468 °C, and contracting surface models for $T \geq 458$ °C; each model yielding their set of apparent activation energy ($E < 41$ kJ mol⁻¹) and pre-exponential factors ($A > 0.04$ s⁻¹) corresponding to rate constants in the range 0.001–0.005 s⁻¹. The HQR was used to investigate the effects of microalgal biomass loading, temperature, and equivalence ratio (ER) on CnHm/CO/H₂ gas yield and composition, carbon conversion efficiency (CCE), and lower heating value (LHV) of syngas under air gasification conditions. Increasing microalgal biomass loading from 1 to 2 g led to a decrease in H₂ content (24.2–19.5 vol %) in the gases. An optimal temperature of 950 °C resulted in the highest H₂, CO, and CH₄ yields at 2.9, 22.8, and 10.1 wt % of biomass from a maximum gas yield of 76.1 wt %, and highest H₂/CO ratio (1.75) and CCE of 56.3%. The effect of ER was measured in two phases 0.1–0.26 and 0.26–35, respectively. During the first phase, the positive effect of ER played a major part compared to second phase, so the H₂ content, H₂ yield, CCE, and LHV were increased.