Experimental Study of CO_2 Recycling using Metal-Oxide Enhanced Coconut Char Gasification: Catalytic Effect of Potassium Carbonate on Gasification

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Biomass gasification is an important process in the production of bio-derived fuels and renewable energy. Biomass gasification with CO_2 is an endothermic process requiring high temperatures, resulting in low process-efficiency. Metals found in the ash in biomass feedstock have shown rate-promoting effects on the C-CO_2 reaction and have motivated the study of low-temperature catalytic gasification. The present study investigates the catalytic effects of potassium (K) on the biomass gasification reactivity of a coconut-derived char (>99.9% carbon) within the temperature range of 600 – 1000 ^{o}C. A wet-impregnation technique is used to prepare K-treated chars. Gasification of the coconut char is conducted within a fixed-bed gasifier with sensitive temperature control (± 10 K). Optical diagnostics, such as laser absorption spectroscopy and non-dispersive infrared absorption spectroscopy, are used to quantify the char mass-loss and instantaneous conversion rate histories. Experimental data show significant increase in gasification rates with the addition of potassium to the chars. Peak gasification rates are observed to increase significantly with addition of K within the temperature range of 600-800 ^{o}C. Peak gasification rates beyond 800 ^{o}C show a non-monotonic trend, which suggests that the high temperature stability of K may have significant effects on its catalytic activity.