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Combustion characteristics and air pollutant formation during oxy-fuel co-combustion of microalgae and lignite

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Abstract

Oxy-fuel combustion of solid fuels is seen as one of the key technologies for carbon capture to reduce greenhouse gas emissions. The combustion characteristics of lignite coal, Chlorella vulgaris microalgae, and their blends under O_2/N_2 and O_2/CO_2 conditions were studied using a Thermogravimetric-Mass Spectroscopy (TG-MS). During co-combustion of blends, three distinct were observed and were attributed to C. vulgaris volatiles combustion, combustion of lignite, and combustion of microalgae char. Activation energy during combustion was calculated using iso-conventional method. Increasing the microalgae content in the blend resulted in an increase in activation energy values for the blends combustion. The emissions of S- and N-species during blend fuel combustion were also investigated. The addition of microalgae to lignite during air combustion resulted in lower CO_2, CO, and NO_2 emission and enhanced NO, COS, and SO_2 formation. In oxy-fuel combustion, the addition of microalgae to lignite enhanced the formation of gaseous species.

Keywords: Oxy-fuel combustion; lignite; microalgae; synergy effect; kinetics analysis; air

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