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Thermochemical conversion of low-rank fuels to bio-based products

Low-rank fuels such as biomass and mixed municipal solid waste (MSW) can be valorised into useful products ranging from chemicals to bio-oil through thermochemical treatment. However, disparate physical and chemical properties of these fuels entail usage of different heating rates for isolating the product of interest. Rapid thermal degradation of biomass is conducive for producing chemicals whereas slow thermal degradation of MSW would facilitate simultaneous investigation of thermochemical breakdown and associated kinetics for bio-oil production. In this study, two different heating rates of 30°C/min and 150°C/min are employed to examine thermal degradation of MSW and biomass respectively through synchrotron infra-red (IR) microscopy. Eight different constituents of MSW namely, yard waste, food waste, paper, rubber, low-density polyethylene (LDPE), polypropylene (PP), poly-(ethylene terephthalate) (PET) and poly-styrene (PS); and biomass (softwood-Pinus radiata), impregnated with five different acid concentration of 0.01M, 0.05M, 0.1M, 0.2M, and 0.5M are considered in this study. Thermal degradation of each constituent of MSW and acid impregnated biomass is performed at 30°C/min and 150°C/min to assess their suitability for producing bio-oil and chemicals respectively. The various aliphatic and aromatic functional groups identified in this study during thermal degradation of MSW prove its suitability for bio-oil production. For biomass, the synchrotron IR analysis shows that acid-impregnation does not alter the surface functional groups but induces catalytic effect during thermal degradation. This information can help in enhancing the yield of bio-oil and chemicals from low-rank fuels through thermochemical treatment.

Keywords or phrases (comma separated)

Biomass, municipal solid waste (MSW), chemicals, bio-oil

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No

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Male

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