Pyrolysis in microwave-assisted pulsed fluidized beds

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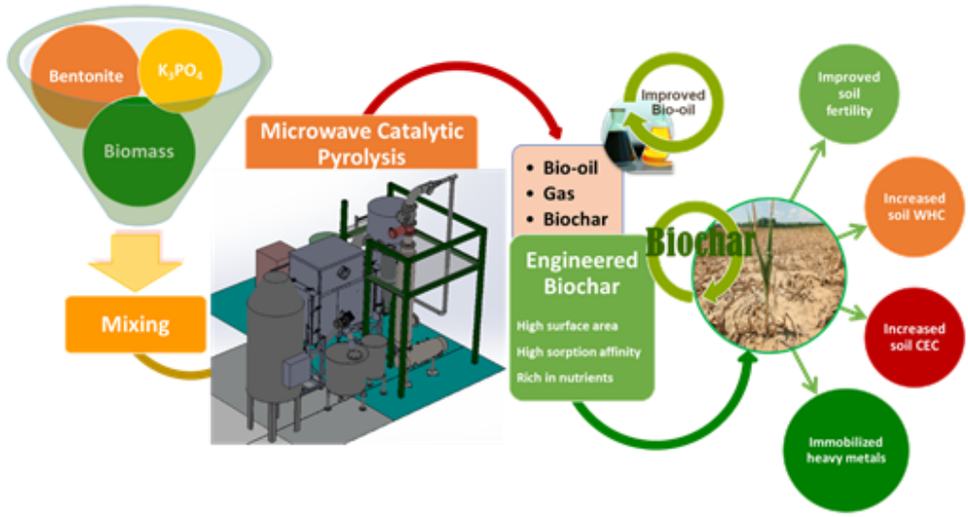
There are estimated 30 million tonnes of forest residues available each year at British Columbia, which can be converted to high-value liquid biofuels or biochemicals. Biomass pyrolysis decomposes biomass under limited oxygen levels or the absence of oxygen under elevated temperatures. Products of pyrolysis are a mixture of gas, liquid and solid. Reaction temperature typically ranges from 300 to 650 °C. Pyrolysis has been identified as a promising pathway for converting biomass residues to liquid biofuels (diesel and jet fuel) and biocarbon.

Sponsors:
Natural Science and Engineering Research Council (NSERC), Canada Foundation for Innovation (CFI)

In fast pyrolysis process, the low quality of bio-oil and biochar imposes challenges in bio-oil upgrading and biochar applications. Specifically, the high oxygen content in bio-oil consumes large amount hydrogen in upgrading operation, which accounts for more than 66% of total greenhouse gas emissions over the whole liquid biofuel supply chain associated with hydrogen production from fossil fuels The poor quality of biochar also surrenders its use as fertilizer for soil applications and as a reducing agent in metallurgical processes.

Microwave heating is a unique and rapid heating method for biomass pyrolysis, and it becomes even more efficient when combined with the high heat and mass transfer rates of fluidized beds so that the quality of bio-oil and biochar could be improved. In the proposed microwave-assisted catalytic pyrolysis process, the unique internal microwave heating of biomass particles created a much porous structure within biochar particles and thus high specific surface area, which in conjunction with remaining natural catalysts as nutrients serve as a high-value carbon-based fertilizer with high water and nutrient holding capacity. The in-situ microwave-assisted catalytic cracking of organic vapours, on the other hand, improved bio-oil quality significantly, as reflected by its low oxygen content, low acidity and low viscosity.
A pilot microwave-assisted horizontal pulsed fluidized bed reactor has been developed for continuous pyrolysis at a biomass feed rate of 10-20 kg/hr. A packed bed condenser was included to extract bio-oil and an afterburner was equipped to combust the non-condensable gases released from the pyrolysis reactor.



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