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Microwave-enhanced pyrolysis of macroalgae and microalgae for syngas production

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Abstract

In this study, three different marine biomasses, i.e., microalgae-spirulina, chlorella and macroalgae- porphyra, were pyrolyzed in a laboratory-scale multimode-microwave cavity at 400, 550 and 700 °C. Ovalbumin and cellulose were also chosen as model compounds to simulate algae. The influence of heating rate on pyrolysis and the β i curves of different samples under different temperatures were studied in detail. The porphyra was found to be the most reactive and produced the most gaseous fraction (87.1 wt.%) amongst the three algae, which comprised of 73.3 vol.% of syngas. It was found that nitrogenated compounds in bio-oil were derived from protein in algae while carbohydrate in algae led to the formation of PAHs. For the production of bio-oil, protein-rich microalgae is favorable compared with porphyra due to their lower amount of PAHs, while porphyra is more suitable for the production of H₂+CO rich gas product, which is comparable with that of conventional gasification process.

Highlights

- Carbohydrate in algae led to higher gas yield whilst protein led to higher oil yield.
- Microwave-enhanced pyrolysis of porphyra resulted in the highest syngas production.
- Microwave-enhanced pyrolysis of spirulina and chlorella favored oil production.

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