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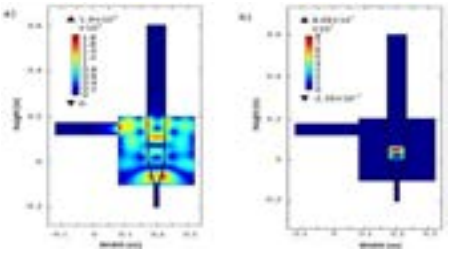
Scalable concepts for microwave pyrolysis

John Robinson
University of Nottingham, UK

Microwave pyrolysis of biomass has long been recognized to provide potential opportunities for producing a range of bio-based products. Unlike conventional heating, microwave heating occurs through the interaction of biomass with electromagnetic energy, with the biomass heated volumetrically by energy conversion instead of conventional heat transfer mechanisms. With microwave heating pyrolysis can be achieved within a cold surrounding environment, a feat that is not possible with conventional heating processes. This unique phenomenon presents a number of opportunities for processing of biomass feed stocks, which include enhanced product quality and a significantly simplified process flow sheet, both of which improve the economic viability of industrial biomass processing. Examples of the benefits of microwave heating include the elimination of size-reduction and particulate removal steps and simplification of inert-gas preparation and recycling systems. These are discussed within the paper, along with the enhanced product quality that can be produced as a result. Previous studies in this field have typically made use of fixed bed reactors, in which heating heterogeneity issues and undesired thermal run away of the biomass are inherent. This paper presents five alternative and scalable microwave processing concepts which have already proven to successfully operate at scale, within an industrial environment. The potential application of these concepts for biomass processing and their ability to deliver a step-change in product quality and flow sheet simplification is discussed within the paper.



Recent Publications

1. C S Lee et al., (2018) Techno-economic assessment of scale-up of bio-flocculant extraction and production by using okra as biomass feedstock. Chemical Engineering Research and Design 132:358-369.
2. B Shepherd et al., (2018) Microwave pyrolysis of biomass within a liquid medium. Journal of Analytical and Applied Pyrolysis. DOI: 10.1016/j.jaap.2018.07.004.
3. Y Zhang et al., (2018) Impact of oil composition on microwave heating behavior of heavy oils. Energy and Fuels 32(2):1592-1599.
4. E T Kostas et al., (2017) The application of microwave heating in bioenergy: A review on the microwave pre-treatment and upgrading technologies for biomass. Renewable and Sustainable Energy Reviews 77:12-27.
5. D Beneroso et al., (2017) Microwave pyrolysis of biomass for bio-oil production: Scalable processing concepts. Chemical Engineering Journal 316(1):481-498.

Biography

John Robinson is an Associate Professor in Chemical & Environmental Engineering at the University of Nottingham. His expertise is in the development and scale-up of microwave heating processes and has taken several processes from a laboratory scale curiosity to a commercial operation. His current research interests are based on understanding the opportunities and advantages for microwave heating within the bioenergy and biorefinery field and developing scalable processes for the pyrolysis of lignocellulosic biomass.

john.robinson@nottingham.ac.uk