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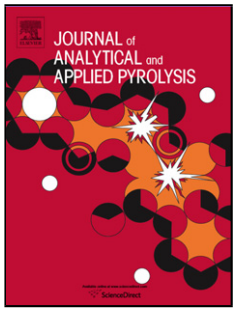

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Microwave pyrolysis of sewage biosolids: dielectric properties, microwave susceptor role and its impact on biochar properties

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Abstract

Microwave assisted pyrolysis (MWAP) is an alternative heating approach to convert biosolids into value-added products, such as biochar, biogas and bio-oil. Studying the dielectric properties of biosolids is fundamental to understand the behaviour of this material under microwave irradiation and to design microwave assisted pyrolysis systems. This study examined the dielectric properties of biosolids with changes in moisture content and applied microwave frequency. Results demonstrated that the dielectric constant decreases with decreasing moisture content and with increasing microwave frequency, but the dielectric loss factor of dry biosolids is almost zero. Simulations demonstrated that moisture content of biosolids impacts on the distribution and intensity of electromagnetic field. Because of the poor dielectric properties of dry biosolids, a microwave susceptor must be added to the biosolids to attract microwave energy so that the materials can reach temperatures required for pyrolysis. Therefore, this study also investigated the impact of four microwave susceptors (activated carbon, charcoal, biochar and glycerol) on biosolids pyrolysis and on biochar properties produced from biosolids via microwave assisted pyrolysis at 600°C. The choice of microwave susceptor influences the heating rate of biosolids and the specific surface area of the resultant biochar. Results show that activated carbon favours the heating process, increases surface area, and the biochar produced with activated carbon has the highest carbon stability and energy value.

Keywords: biosolids; biochar; carbon stability; dielectric properties; microwave pyrolysis; microwave susceptor.

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