Structural and thermal analysis of bio-based polybenzoxazine derived from liquefied empty fruit bunch (EFB) via solventless method

Rohimi, Nurfatin Farhanah[a]; Yaakob, Muhd Nor Arifin[a]; Roslan, Rasidi[a]; Salim, Nurjannah[a]; Mustapha, Siti Noor Hidayah[a]; Rahim, Mohd Hasbi Ab[a]; Chia, Chin-Hua[b]; Zakaria, Sarani[b]

[a] Advanced Material Group, Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, Pahang, Kuantan, Gambang, 26300, Malaysia

[b] Bioresources and Biorefinery Laboratory, Materials Science Program, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Bangi, 43600, Malaysia

ABSTRACT

A bio-based polybenzoxazine demonstrating excellent thermal properties was synthesized using phenolic and its derivatives derived from liquefaction of empty fruit bunch (EFB) fibres to fulfill green chemistry principles. The liquefied EFB was reacted with furfurylamine and paraformaldehyde through a Mannich condensation reaction. For comparison purposes, a guaiacol polybenzoxazine was synthesized using guaiacol as a phenolic component reacted with similar amine and aldehyde. Both types of polybenzoxazine synthesized from liquefied EFB and guaiacol were named L-fa and G-fa, respectively. The structural analysis was performed using Fourier-Transform Infrared (FTIR) and proton Nuclear Magnetic Resonance (1H NMR). It was observed that the synthesis of benzoxazine groups for both types of polybenzoxazine was successful with the formation of the oxazine ring. Thermal stability showed that liquefied EFB polybenzoxazine (L-fa) has higher thermal stability above 360 °C compared to guaiacol-polybenzoxazine (G-fa), which is higher is 280 °C due to the complex structure of the lignin derivative in the liquefied EFB. For polymerization behavior, L-fa exhibit two exothermic peaks compared to three peaks on G-fa, indicating that L-fa is more reactive due to additional polymerizable sites present in L-fa. This work widens the synthesis route for the preparation of bio-based benzoxazine derived from oil palm waste which will perpetuate outstanding evolution towards the sustainable development of the bio-based polymeric industry.

KEYWORDS

Guaiacol; Liquefaction; Polybenzoxazine; Renewable polymer; Solventless method; Thermoset

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