

Article

Chemical Recycling of Fully-Recyclable Bio-Based Epoxy Matrices based on Epoxidized Precursors derived from Waste Flour: Chemical and Thermo-mechanical Characterization of the Recycled Polymers

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Abstract: This study aims to investigate the chemical recycling of two different fully-recyclable bio-based epoxy matrices based on epoxidized precursors derived from waste flour. The key for their recyclability relies on the use of cleavable hardener. In fact, the latter contains a ketal group in its chemical structure, which is cleavable in mild acetic conditions, so allowing for the breakage of the cured network. The recyclability was successfully assessed for both the two investigated formulations, with a recycling process yield ranging from 80 up to 85%. The recycled polymers presented a T_g up to $69.0 \pm 0.4^\circ\text{C}$, determined by mean of DMA and DSC analysis. Next, the TGA revealed that the thermal decomposition of the specimens primarily occurred around 320°C , attributed to the breaking of C–O and C–N bonds in crosslinked networks. In the end, the chemical characterizations were carried out by mean of Py-GC/MS, MALDI-TOF-MS and FT-IT ATR. In fact, these analysis allowed to investigate how the recycled polymer's structure changed, starting from the initial epoxy systems. This insights on their chemical structure could further allow to identify re-use strategies in accordance with a circular economy approach.

Keywords: recyclable thermosets; circular economy; chemical recycling; bio-based epoxy resins; organic waste; bio-content; green epoxidation

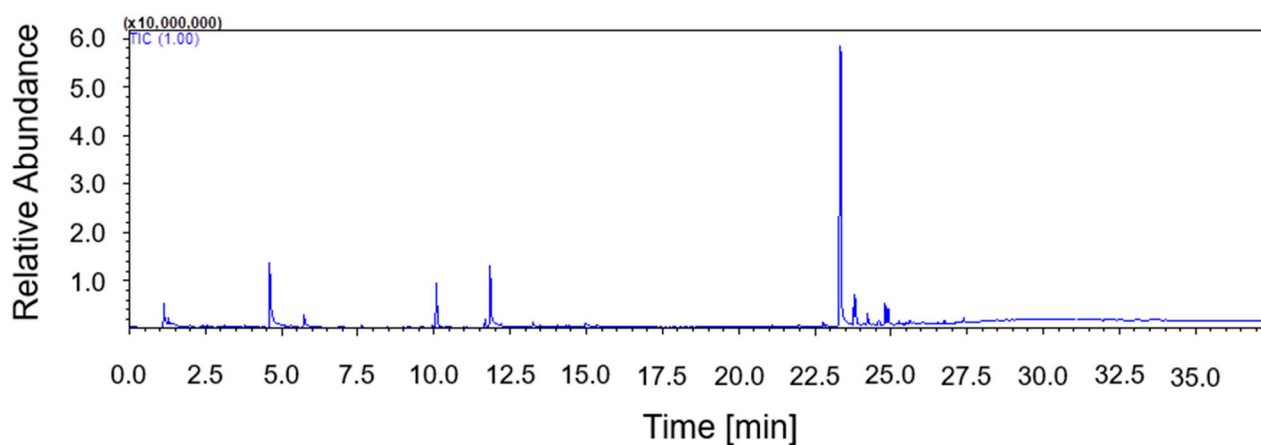


Figure S1. Pyrolysis-GC/MS acquired chromatogram of epoxy system EWF100_A22 decomposition in helium.

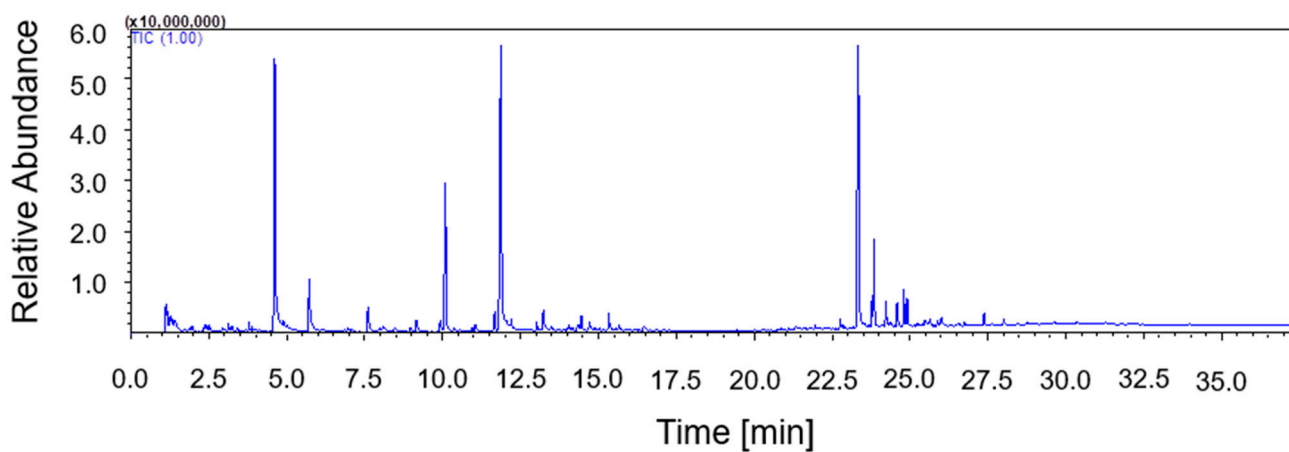


Figure S2. Pyrolysis-GC/MS acquired chromatogram of epoxy system rEWF100_A22 decomposition in helium.