The engineering of biobased epoxy resin

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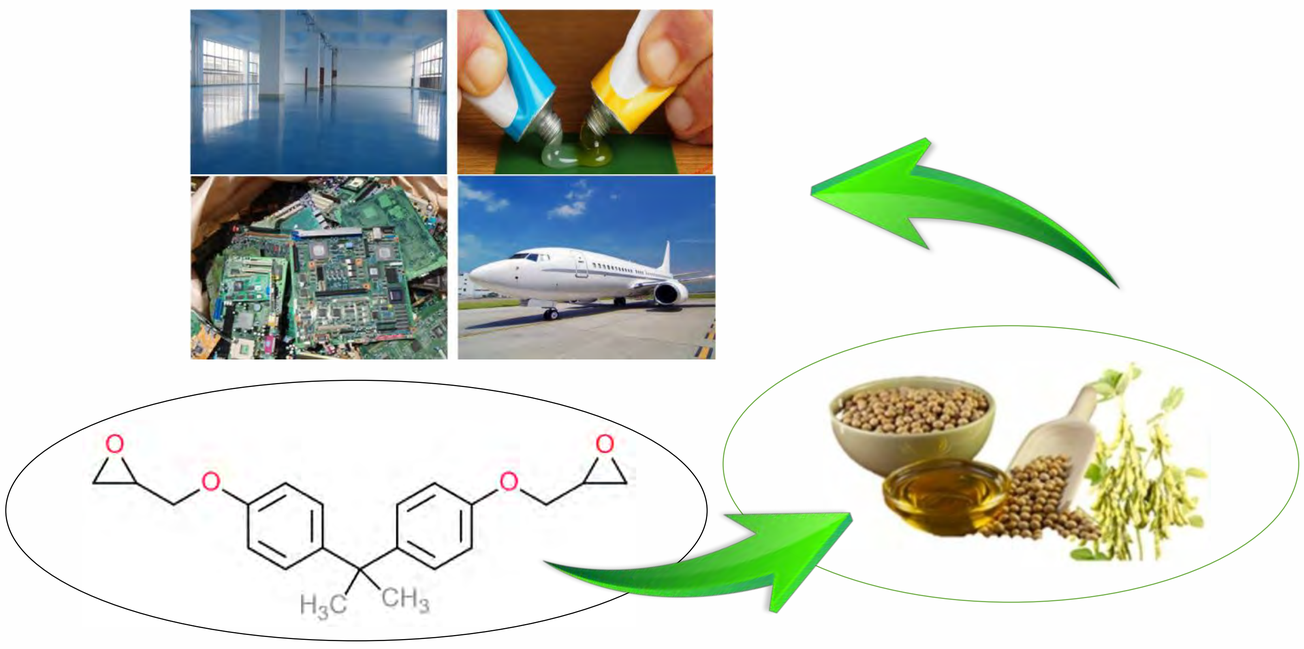
Introduction

Many epoxies are based on bisphenol A diglycidyl ether (BADGE), which is derived from bisphenol A [1]. The European Union has adopted a ban on the use of BPA-derived materials in food contact materials, due to health and safety concerns [2].

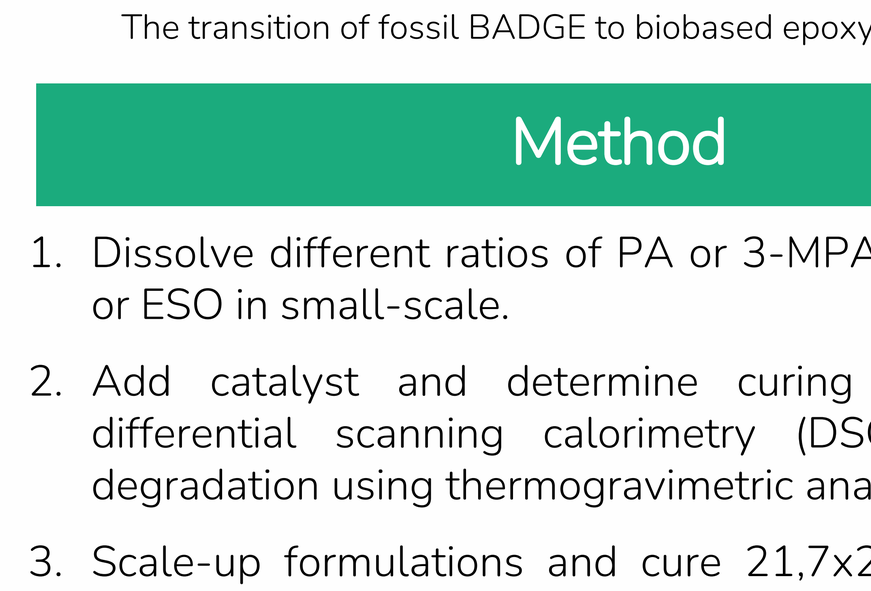
To find an alternative to BADGE, promising biobased alternatives like glycerol diglycidyl ether (GDE) and epoxidized soybean oil (ESO) will be cured and tested on thermo-mechanical properties. Partial biobased epoxies will be crosslinked using phthalic anhydride (PA) and fully biobased with 3-methylphthalic anhydride (3-MPA).



The transition of fossil BADGE to biobased epoxy material [3] [4].

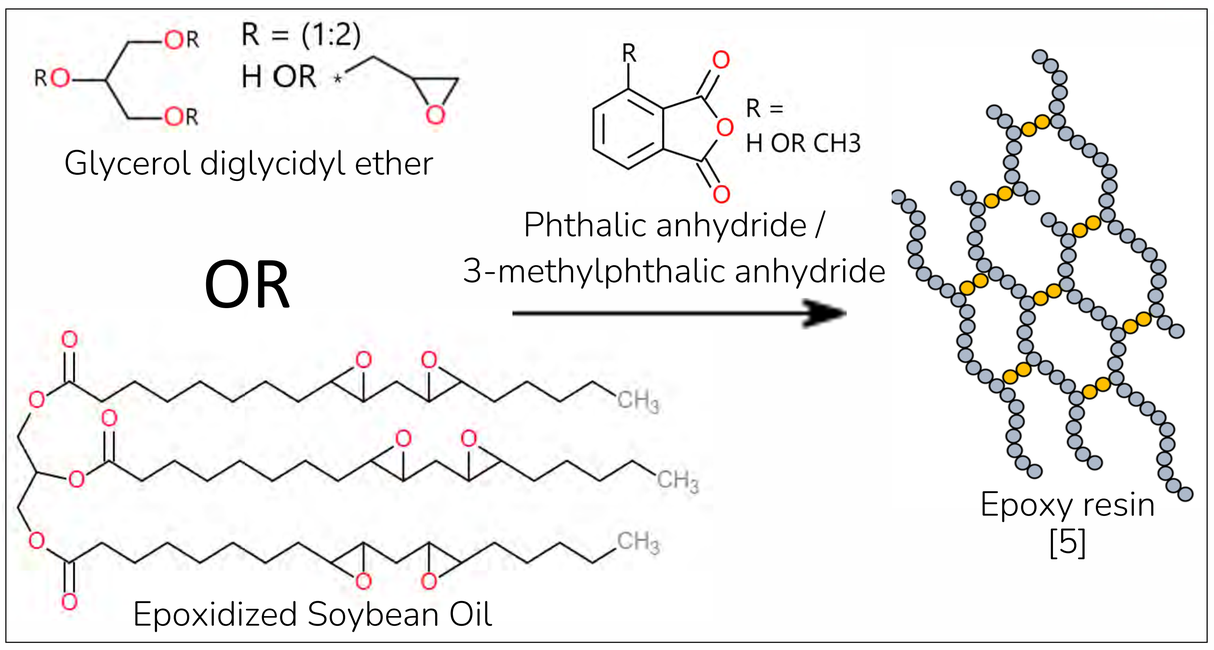
Method

1. Dissolve different ratios of PA or 3-MPA in BADGE, GDE or ESO in small-scale.
2. Add catalyst and determine curing behaviour with differential scanning calorimetry (DSC) and thermal degradation using thermogravimetric analysis (TGA).
3. Scale-up formulations and cure 21,7x21,7x2mm plates for 1h.
4. Characterization of thermal-mechanical properties: glass transition temperature, degradation temperature, tensile, hardness & optical contact angle.
5. Optimize formulations and repeat.



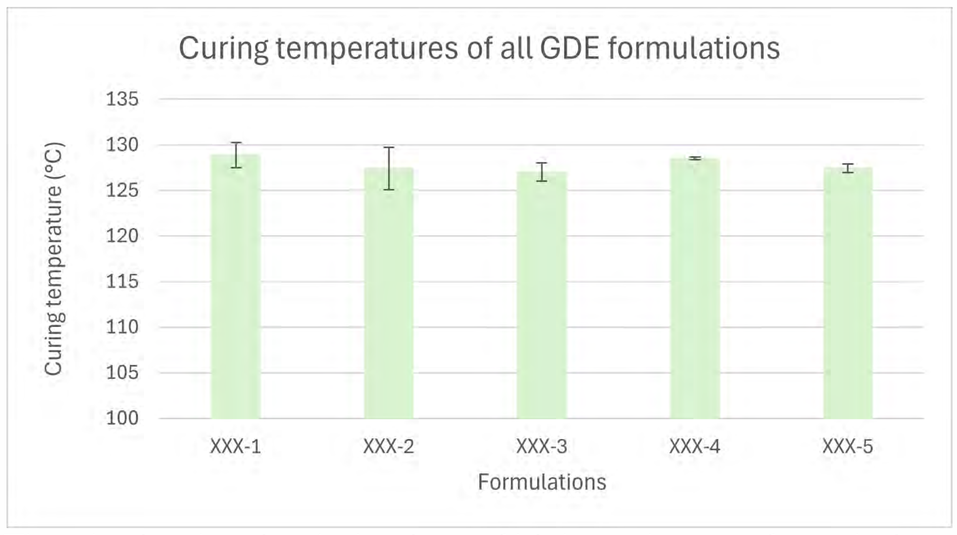
The schematic view of the methodology used.

An example of an epoxy plate

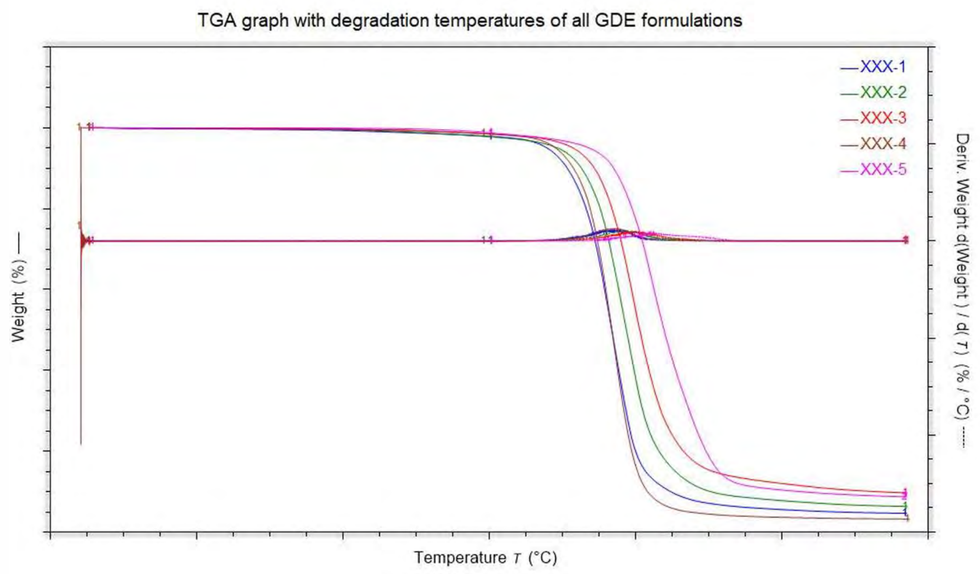


Results

- All formulations containing GDE fully cured.
- Formulations containing ESO have difficulties curing.
- Thermal properties of all GDE formulations are comparable to BADGE.



The obtained curing behaviour of biobased epoxy formulations using DSC.



The obtained thermal degradation of biobased epoxy formulations using TGA.

Conclusion

GDE-based epoxy can form an epoxy plate and has shown similar thermal properties compared to BADGE, although mechanical properties testing still needs to be performed.

References

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