ISGC 2022

N°201 / OC
TOPIC(s) : Polymers or composites / Industrial chemistry

# Mastering the oligomerization degree of biobased epoxides: impact on their processability and associated material properties

## AUTHORS
Samuel MALBURET / SPECIFIC POLYMERS, ZAC VIA DOMITIA, 150 AVENUE DES COCARDIÈ, CASTRIES

## PURPOSE OF THE ABSTRACT

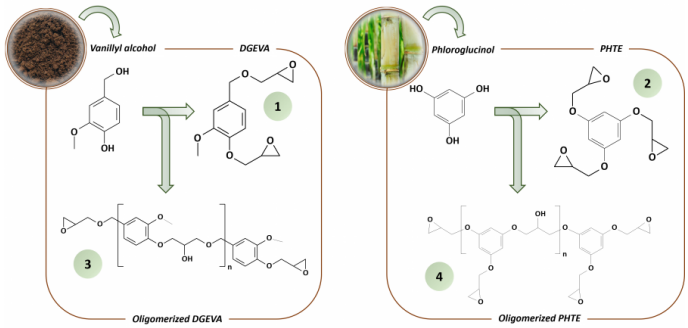
Finding suitable alternatives to the use of diglycidyl ether of Bisphenol-A (DGEBA) in epoxy-based materials is among of major topics for several years. Its controversial aspect due to the endocrine nature of its precursor, the Bisphenol-A, combined with the growing demand of sustainable and biobased materials are forcing industrials to bring new solutions to the market.

However, although many innovative epoxies were developed so far, obtaining similar specifications than DGEBA-based resins such as thermo-mechanical properties, viscosity and thermal and chemical stability remain crucial challenges to overcome. For this reason, important researches from SPECIFIC POLYMERS were dedicated over the past few years to (i) the identification and selection of viable and economical natural molecules, (ii) the synthesis of processable epoxy intermediates and (iii) their formulation with suitable hardeners to reach sufficient thermo-mechanical performances.

The first stage was devoted to the identification of durable and non-toxic materials that could be used for the preparation of epoxies. The selection was based on several criteria such as their (i) naturalness (ii) accessibility and expected (iii) thermo-mechanical performances. Based on these criteria, the vanillin (potentially extracted from lignin)1 and the phloroglucinol (potentially extracted from algae or obtained through sugar bioconversion)2 were identified as promising candidates due to their natural phenolic structure. Their conversion into epoxides by the action of epichlorohydrin allowed to obtain di- and tri-functional epoxies namely the diglycidyl ether of vanillyl alcohol (DGEVA) (Figure 1, structure 1) and the triglycidyl ether of phloroglucinol (PHTE) (Figure 1, structure 2).
However, when the ideal structures are obtained, both epoxies are solid with respective melting point evaluated by Differential Scanning Calorimetry (DSC) around 45-50°C and 60-65°C making them not compatible with low temperature processes where DGEBA is intensively used. Therefore, the experimental conditions were adapted for each reference making it possible to master the oligomerization degree and finally obtain non-crystalline epoxy derivatives (Figure 1, structures 3 and 4) with adequate viscosity to be processed in mild temperature conditions.

In the last phase, their formulation with amine curing agents were performed. By varying the structure and nature of amines as well as by adjusting the DGEVA/PHTE mixture it was possible to reach glass transition temperature from 60 to 180°C and to adapt the gel time and viscosity to satisfy several process requirements.

## FIGURES




## FIGURE 1

Figure 1.

Structure of epoxies prepared from vanillyl alcohol and phloroglucinol

## FIGURE 2


## KEYWORDS

Bio-based Epoxy Resins | DGEBA alternatives | Diglycidylether of Vanillyl Alcohol | Trigycidylether of Phloroglucinol


## BIBLIOGRAPHY


[1] E. D. Hernandez et al., Synthesis and Characterization of Bio-based Epoxy Resins Derived from Vanillyl Alcohol, ACS Sustainable Chem. Eng., 4 (2016), 4328–4339

[2] Centre National De La Recherche Scientifique (C.N.R.S), Université Pierre Et Marie Curie (Paris 6), patent WO2013045510A9, 2011