

## Modified biobased resins for sustainable thermosets

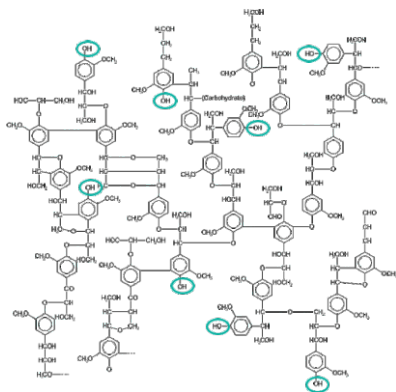
### Motivation

Due to the limited availability and the high CO<sub>2</sub> footprint, a future replacement of petrobased raw materials/polymers by biobased ones is essential. A focus on the use of natural biopolymers is preferable, as the (energy) efforts required for the fabrication of biobased monomers and for polymer synthesis reactions is largely eliminated. An example of a biopolymer obtainable in large quantities (~120 million t/year) is lignin, which is a by-product of cellulose fabrication and is currently mainly used for energy generation.

The objective is to modify existing biopolymers via sustainable technologies and lean processing chains for suitability as resin/crosslinker components in duromers for specific applications (thermosets/fiber reinforced composites/coatings). Depending on the application, the desired material properties of these biobased thermosets should be tailored to the property portfolio of petrobased materials, recyclable or biodegradable.

### Example:

Modification of lignin to adapt its thermal properties to the requirements in thermosets



Detail of lignin structure  
([https://de.wikipedia.org/wiki/Lignin#/media/Datei:Lignin\\_structure.svg](https://de.wikipedia.org/wiki/Lignin#/media/Datei:Lignin_structure.svg))

Lowering the softening temperature



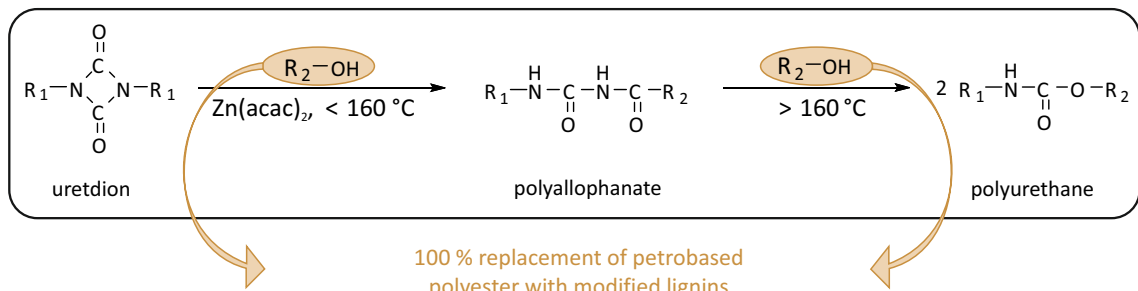
Biobased resins for thermosets



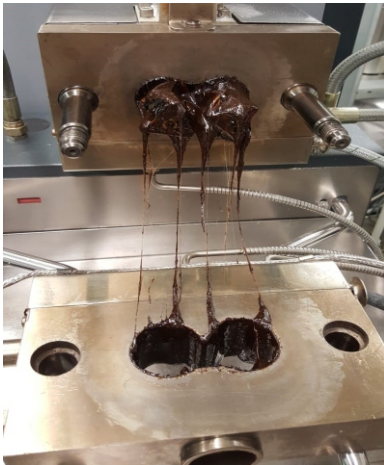
Biobased resin based on modified lignin

### Example:

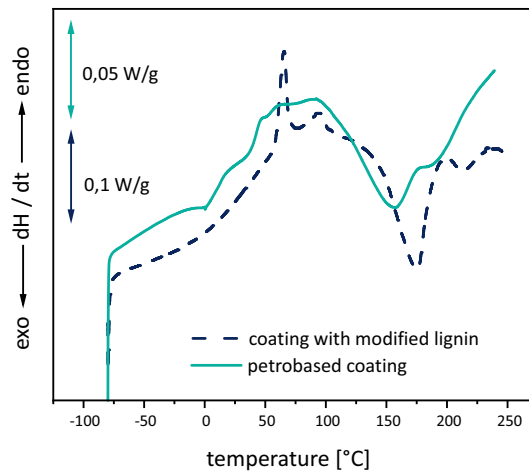
Melt homogenization of powder coating duromer components in the kneader



Catalyzed two-step crosslinking reaction of the powder coating by using biobased resins

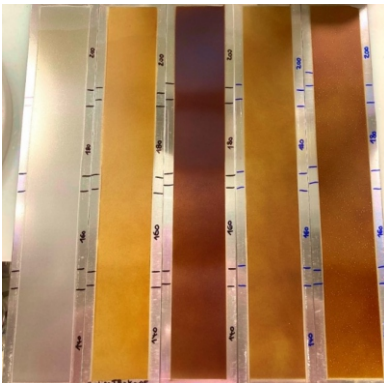


Discontinuous melt homogenization in the kneader



DSC curve: comparison of a petrobased powder coating with a powder coating based on modified lignin as polyester resin

### Crosslinked, lignin based powder coating films



Unpigmented



Pigmented and after impact/rev. impact testing

### Innovative benefits of using lignin based resins for thermosets

- Replacement of petrobased resins by renewable, modified, biobased polymers
- Direct use of bio-/residual polymers, saving of process and reprocessing steps and energy
- Curing reaction runs analogously to petrobased systems, highly flexible films and post-formability of pre-coated sheet materials can be performed

## Contact

Leibniz-Institut für Polymerforschung Dresden e. V.

Abteilung Werkstofftechnik

Dr. Michaela Gedan-Smolka

E-Mail: [mgedan@ipfdd.de](mailto:mgedan@ipfdd.de)

T +49 (0)351 4658 448

Dr. Katrin Schubert

E-Mail: [schubert@ipfdd.de](mailto:schubert@ipfdd.de)

T +49 (0)351 4658 577

Hohe Straße 6 . 01069 Dresden . Germany

[www.ipfdd.de](http://www.ipfdd.de)