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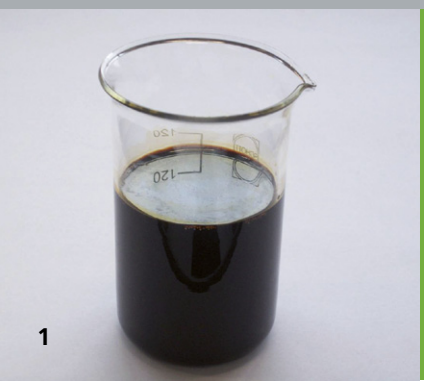
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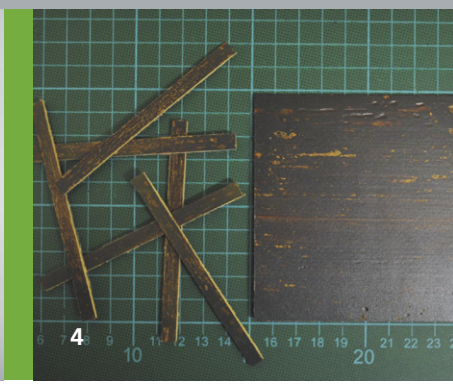
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1 *Black liquor.*
2 *Lignin (pure).*
3 *Thermosets [40 % lignin].*
4 *Composites [60 % fibers].*

ISOLATION, CHARACTERIZATION, AND PROCESSING OF LIGNIN

Isolation:
from black liquor at fixed pH-values.
Fractionation:
with solvents of various polarities.
Aim:
lignin fractions with tailored properties.

Lignin characterization

- solubility measurements in selected solvents
- determination of composition: ash content, cellulosic residues, elemental analysis (CHNS, O)
- determination of OH-number (overall): titration
- quantitative determination of OH-group types: ^{31}P-NMR spectroscopy
- determination of aliphatic/aromatic OH-group ratio for lignin esters: ^{1}H-NMR, FTIR
- thermal stability investigations: TGA
- glass temperature determination: DSC

Material development with lignin

Thermoplastic lignin derivatives

- lignin derivatization: esterification, etherification, urethane formation
- processing: kneader, twin screw extruder, injection molding

Lignin-based thermosets

- recipe development for resins (UF, PF, UP, epoxy)
- molding of test specimen

Manufacture of composites (thermoplastic, thermoset)

Mechanical, thermomechanical, and structure characterization

- tensile, bending, HDT
- X-ray analysis
- electron microscopy (SEM, TEM)
- nuclear magnetic resonance (liquid, solid state)

Fraunhofer Institute for Applied Polymer Research IAP

Potsdam-Golm Science Park
Geiselbergstr. 69
14476 Potsdam-Golm
Germany

Contact

Dr. Gunnar Engelmann
Phone +49 331 568-1210
gunnar.engelmann@iap.fraunhofer.de

www.iap.fraunhofer.com

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