PRESS AND JOINING TECHNOLOGIES

Manufacturing of Natural Fiber Reinforced Organo Sheets

Salmins, M.; Gortner, F.; Mitschang, P.

Leibniz-Institut für Verbundwerkstoffe

OBJECTIVES

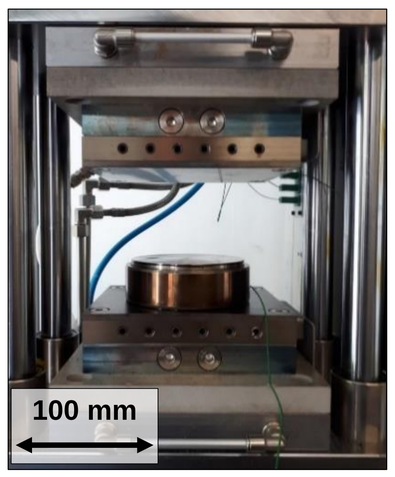
State of the Art and Challenges

- Use of natural fiber in non-woven or fiber reinforced injection molding granules
- Limited mechanical properties due to random fiber orientation
- Decrease in fiber properties due to thermal degradation of fiber components

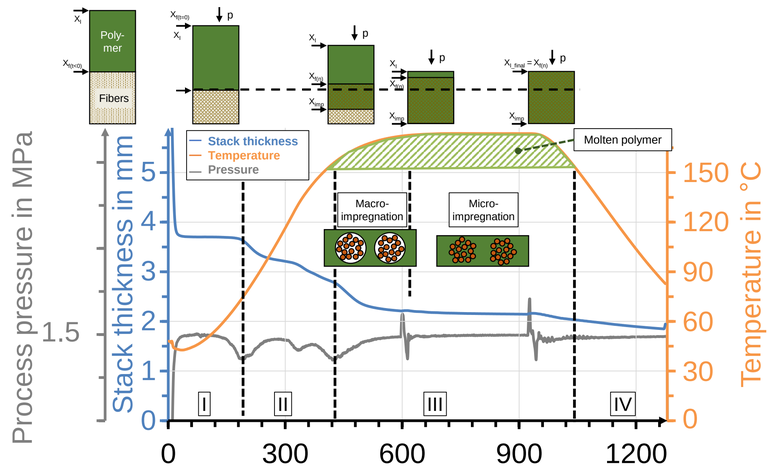
Investigation of Process Design for Optimized Property Profile

- Enabling of impregnation without reduction in fiber properties through thermal damaging or degradation of natural fiber components
- Use of rPLA powder with temperature compatibility due to low melt temperature
- Investigation on a laboratory scale for efficient investigation of process parameters process pressure (p_{max}) and process temperature (T_{max})
- Efficient material use during manufacturing: specimen with a diameter of 100 mm and a target thickness of 1.9 mm and fiber volume content of 50 %
- Evaluation of apparent impregnation quality after processing due to stack setup
- Evaluation of the impregnation process based
  - on process data and B-factor model
  - Three-point-bending specimen (80 mm x 15 mm) according to DIN EN ISO 14125

Laboratory Hot Press

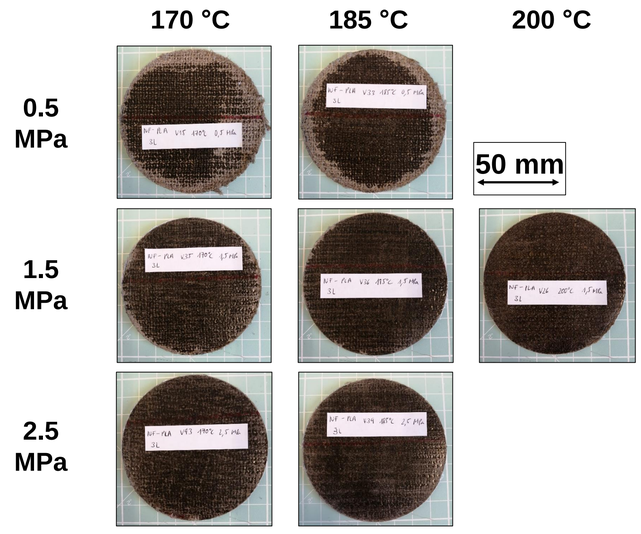


Data-based Evaluation of Impregnation Process

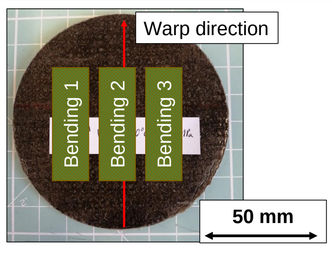


Stack Setup

Evaluation of Impregnation Quality

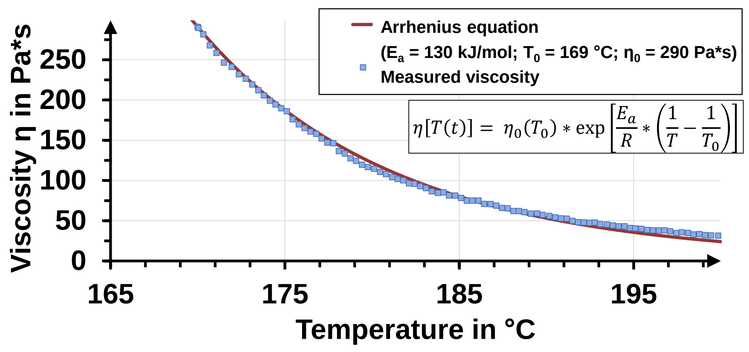


Preparation of Specimen for Bending Tests

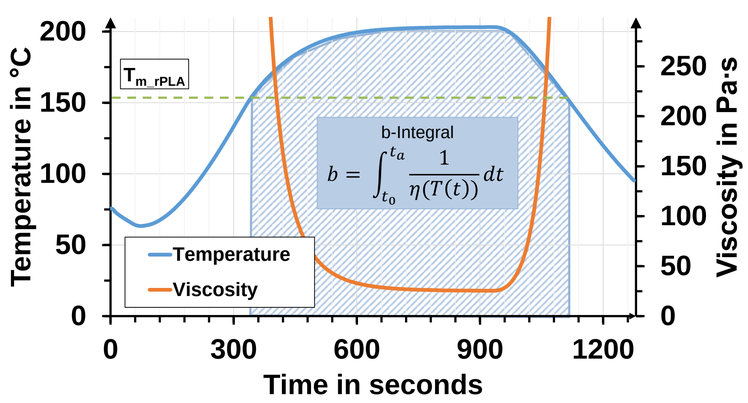


RESULTS

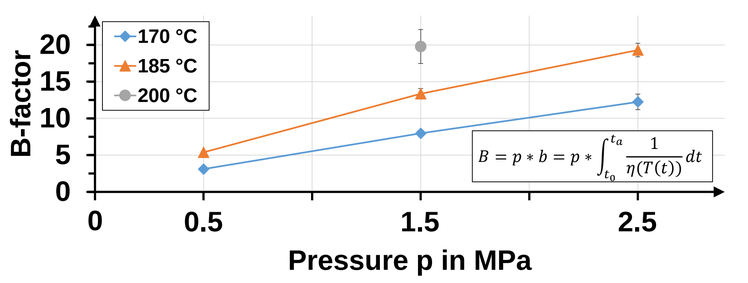
Polymer Melt Viscosity



Calculation of b-integral

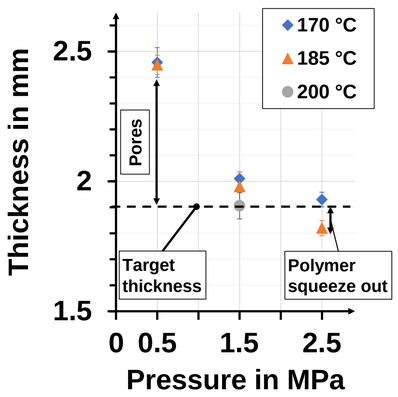


Parameter dependent B-factor



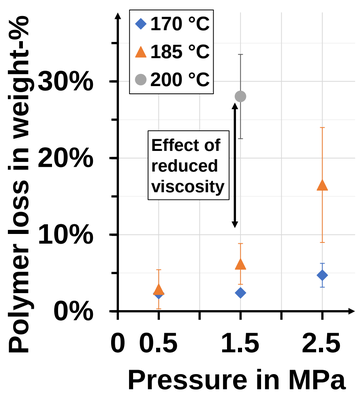
Investigation of Process Influence on Organo Sheet Properties

Absolute Thickness



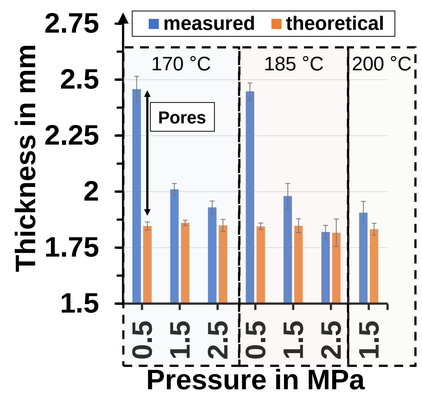
- Thickness has to be compared to fiber and matrix weight and content

Polymer Squeeze Out



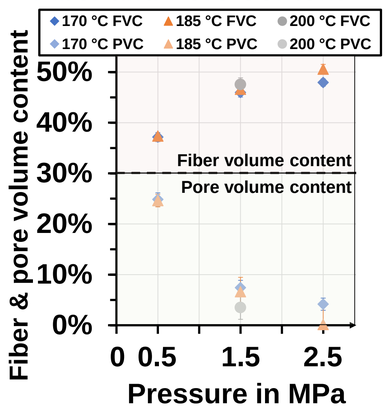
- Matrix weight is reduced by both temperature and pressure due to matrix squeeze out

Thickness Comparison



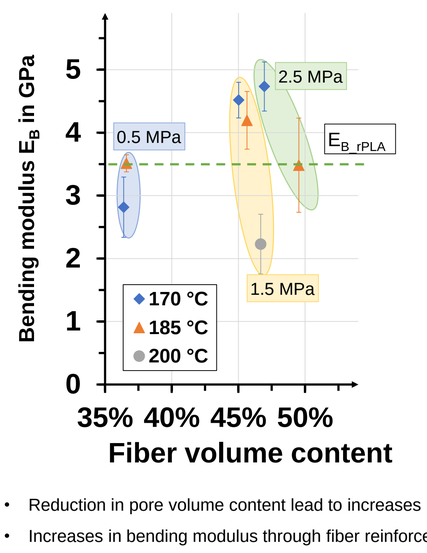
- Determination of pore content by comparison with theoretical organo sheet thickness

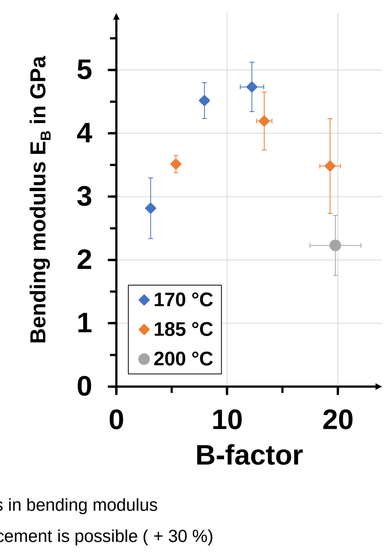
Fiber and Pore Content



- Reduction in pore volume content through pressure increase

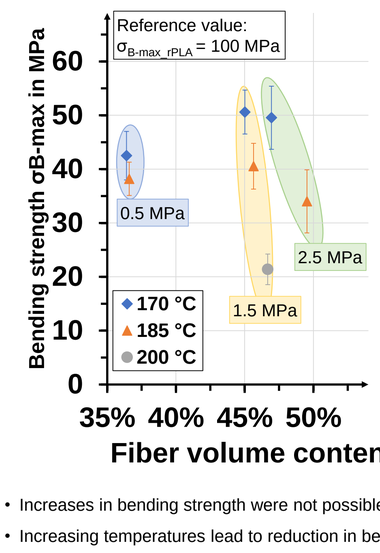
Bending Modulus

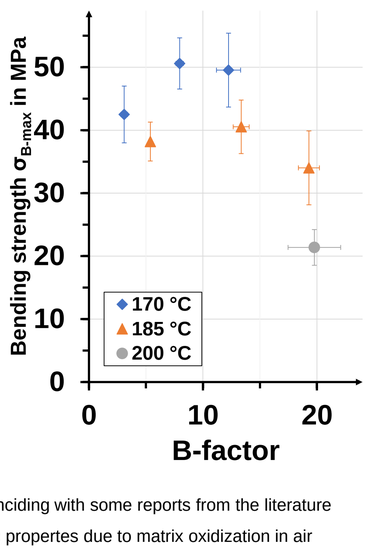




- Reduction in pore volume content lead to increases in bending modulus
- Increases in bending modulus through fiber reinforcement is possible (+ 30 %)

Bending Strength





- Increases in bending strength were not possible; coinciding with some reports from the literature
- Increasing temperatures lead to reduction in bending propertes due to matrix oxidization in air

NEXT STEPS

Integration of process design into Durobast value chain (www.durobast.de)

- Processing of locally sourced hemp fiber textiles developed at Institut für Textiltechnik of RWTH Aachen and manufactured at Wagenfelder Spinnereien GmbH and Gustav Gerster GmbH & Co. KG
- Investigation of cavity polymerization potential for reduction of moisture absorption - by project partners Fraunhofer LBF
- Life Cycle Analysis based on the whole value chain – by project partner nova institute
- Scale-Up into industrial scale on conventional compression molding equipment IVW together with project partner at Coats Group
- Investigation of fatigue behavior of standard textiles and those with cavity polymerization – tested by project partners at Chair of Material Testing (WPT) of TU Dortmund University

ACKNOWLEDGEMENTS

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FNR Fachagentur Nachwachsende Rohstoffe e.V.

Leibniz-Institut für Verbundwerkstoffe GmbH, Erwin-Schrödinger-Straße 58, 67663 Kaiserslautern, Germany