Bio-based Materials for 3D- Printing

From side streams to 3D-printable bio-based materials

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Dr. Rathish Rajan
RDI Specialist
Chemistry & Bioeconomy Team
Centria University of Applied Sciences, Finland

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Commercial biocomposite 3D-printing materials already exist - so why BIO-2-PRINT?

Market examples show that biocomposites can be printable. BIO-2-PRINT explores how local side streams can become reliable, application-specific FGF materials

Existing market examples

KCL Formi 3D: Cellulose-fibre reinforced PLA grades for large-scale additive manufacturing

DuraSense 3D: Wood-fibre reinforced thermoplastic grades for 3D printing

What this proves: Natural-fibre composites can be processed as pellet-based feedstocks for large-scale printing

KCL Formi™ 3D Nordic Birch Grades

Source: KCL-Biocomposites

DuraSense granules

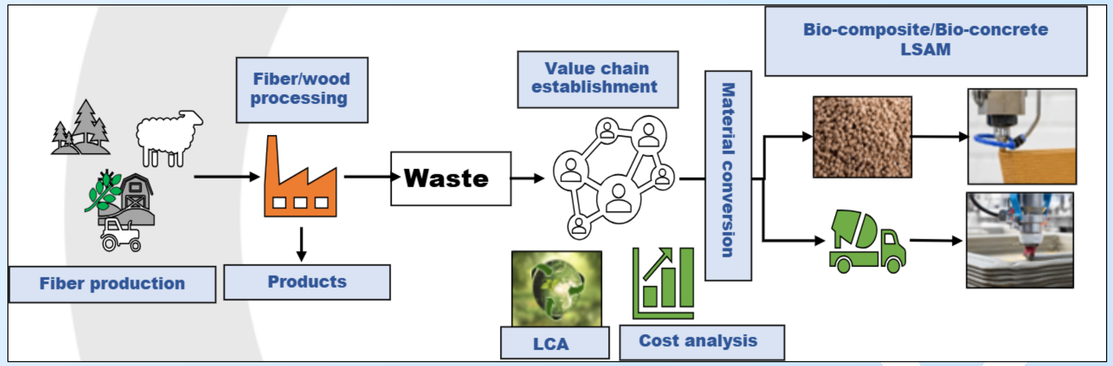
Source: Bioenergy International

Why new material developement still matters?

Local availability: Regional underutilized side streams as feedstocks

New fibre sources: inner bark, boat-industry wood waste, wool and other streams

Circular economy: Utilizing waste fibres from production line to produce new recyclable products



Overview: development of biocomposites from waste biofibres

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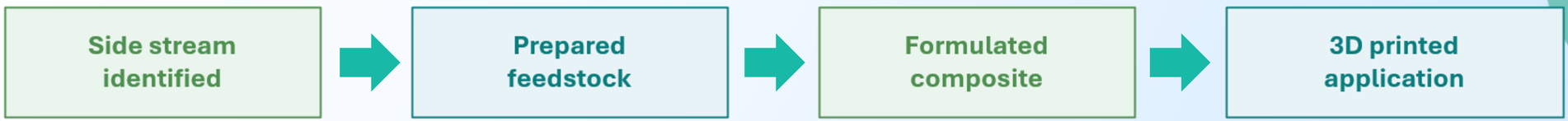
Underutilized fibres as 3D printable feedstock

Availability is only the first question – printability and performance decide material value



Can underutilized fibres and side streams become reliable, printable materials?

- Material must feed reliably
- Melt and flow without degradation
- Form a stable bead and layer structure
- Adhere to the bed and resist warpage
- Properties

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Materials investigated

A broad screening phase before focusing on the most promising candidates

Underutilized fibres

- Inner bark
- Boat-industry wood waste
- Wool fibres
- Hemp hurds
- Seaweed
- Reindeer hair

Functional additives from underutilized fibres

- Suberin from inner bark
- Lanolin from wool
- Condensed tannins and phosphorus rich-side streams

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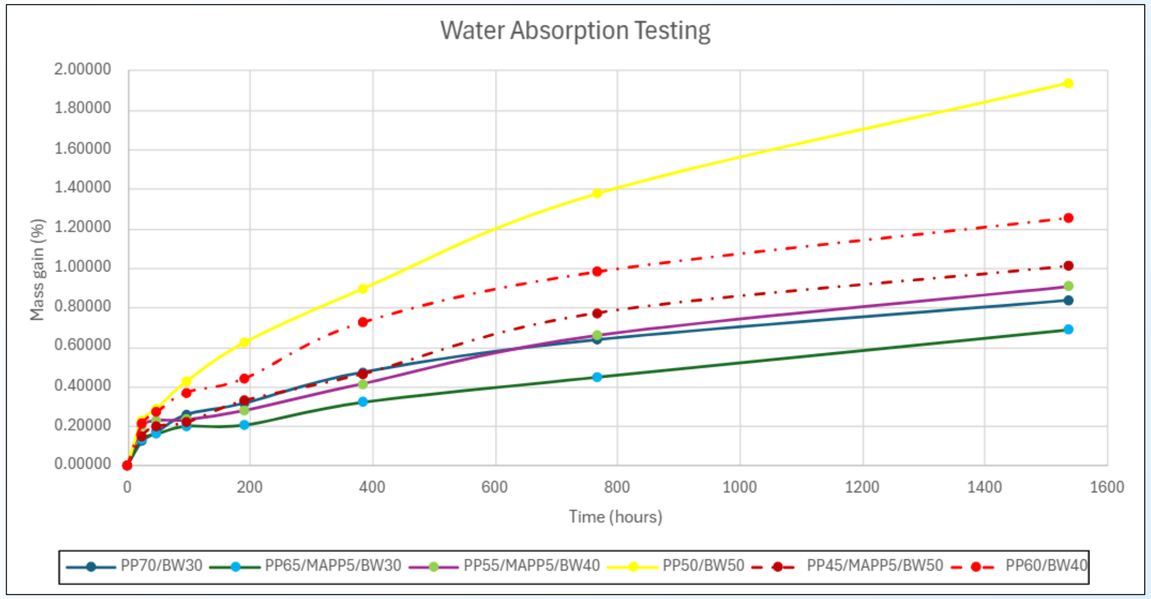
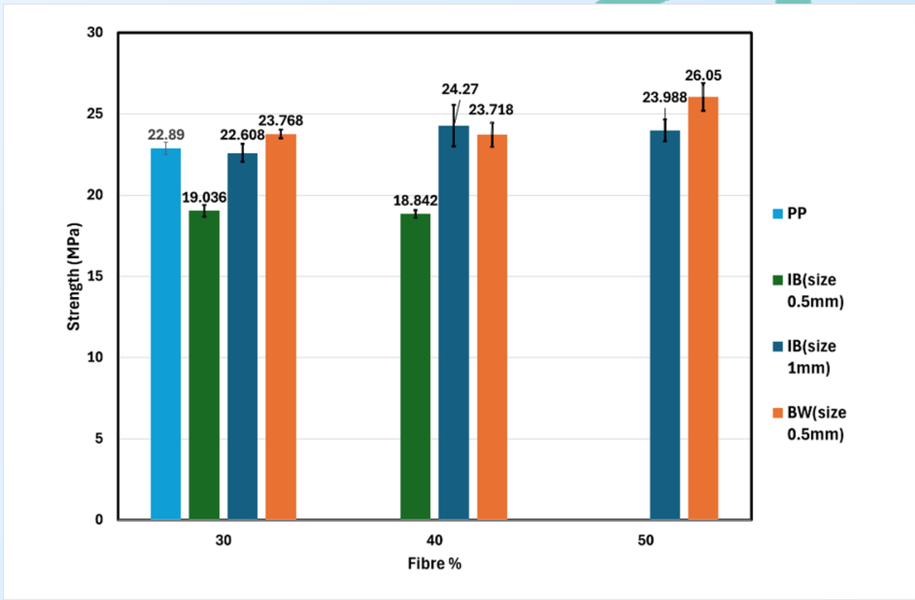
Polymer composites: what worked best?

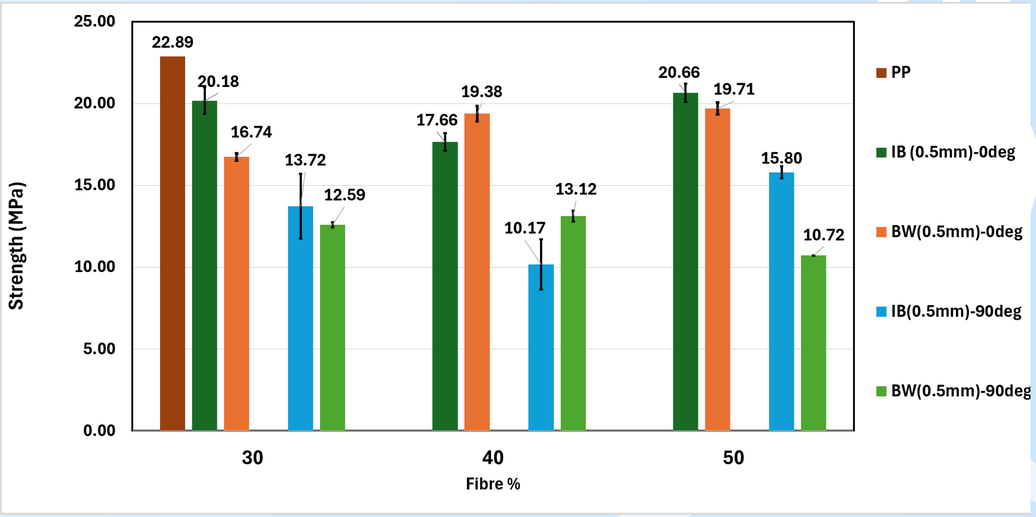
Inner bark and boat-industry wood waste became the main PP candidates for FGF

Main result

40 - 50 wt% inner bark or boat-industry wood waste in PP were selected for continued FGF optimization







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Fibre preparation changed printability

Same material, different processing behaviour

Coarser or less uniform filler

- Rougher bead surface
- Less uniform flow
- Higher risk of visible pores

Finer ground filler

- More stable deposition
- Better bead formation
- Easier parameter control

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FGF printability: stable extrusion is only step one

Printing success was controlled by the full process window, not only by whether material came out of the nozzle

Extrusion
stable flow

→

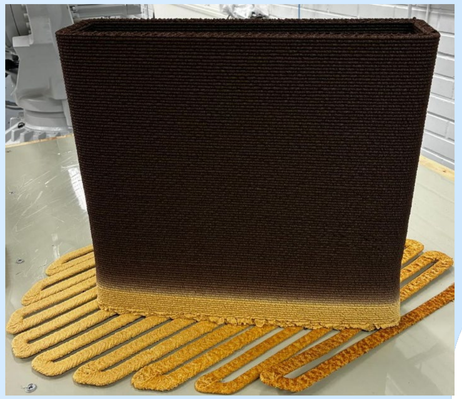
Bead
shape + surface

→

Bed
adhesion

→

Part
warpage + pores



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Functional additives: higher-value use of bio-based streams

Suberin and lanolin were studied in PLA as candidates for plasticization or toughening

Lanolin at 3-5 wt.% gave the clearest ductility improvement while retaining tensile strength close to PLA

Impact testing is still needed before calling the additives impact modifiers

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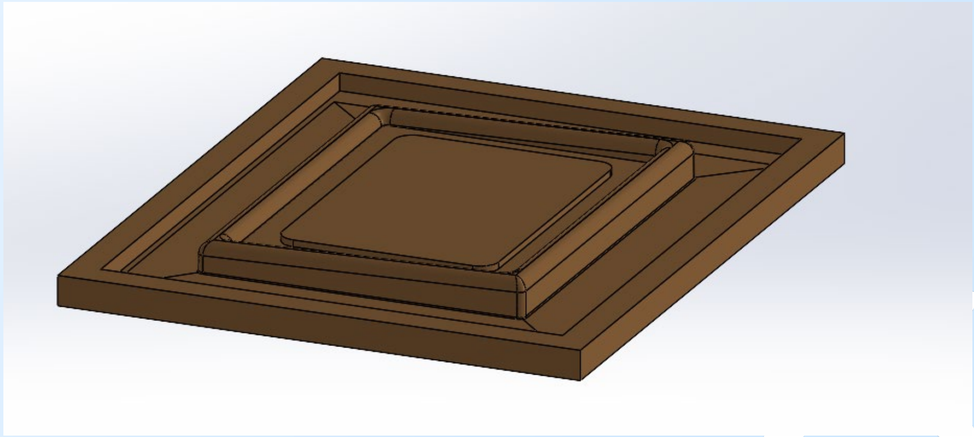
Towards application: demonstrator-oriented validation

The next question is not only “Can it print?” but “Can it print the right geometry with repeatable quality?”



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Conclusions

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