NATIONAL COMPOSITES CENTRE

Bristol Composites Institute

University of BRISTOL

Industrial Processing of Biocomposites: Opportunities and Challenges

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Date 11/10/2023

The Challenge

Biocomposites have environmental benefits, but industry need to see performance and processing data

110,000 tonnes tonnes of FRPs produced in the UK in 2019

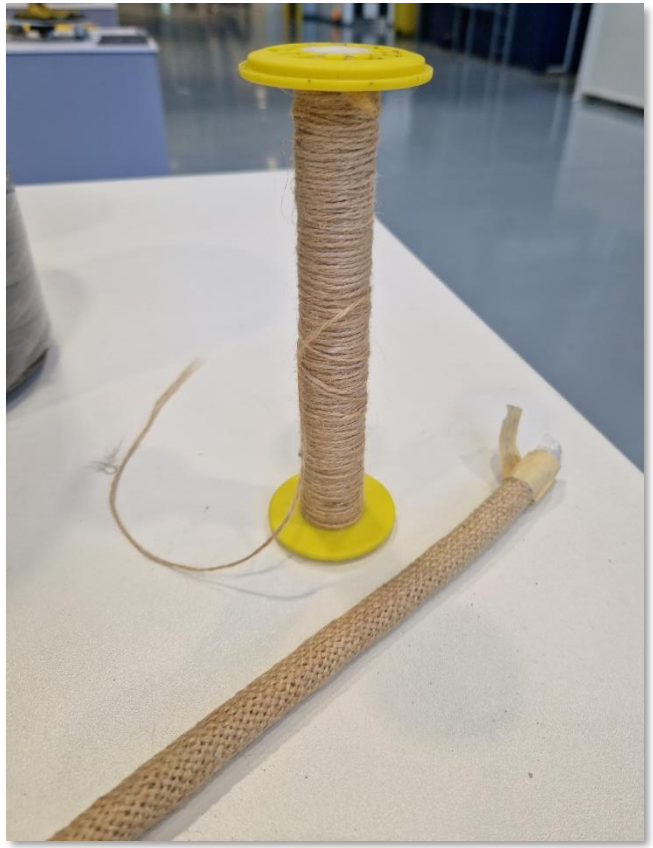
But only **6%** were reused

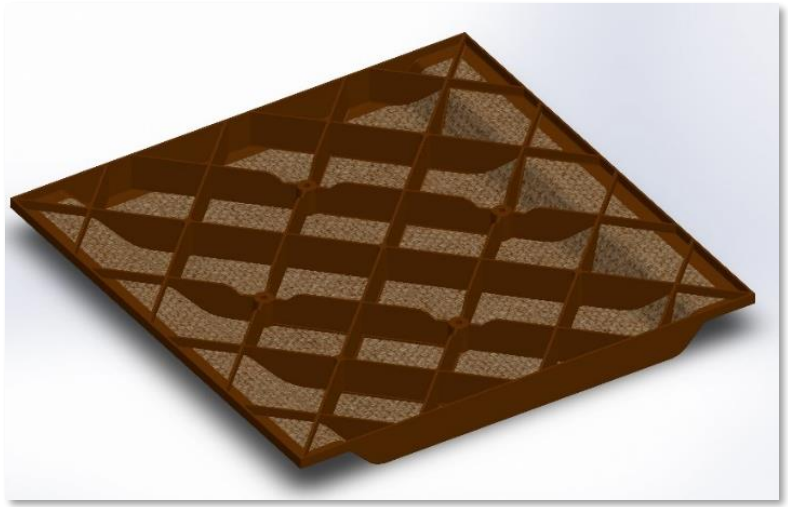
Barriers to uptake in bio-composites

1. Mechanical and Environmental Performance Data
2. Material Processing not well understood
3. Perceived high cost

NCC Work

Experience in flax end applications as an independent manufacturer





Sustainable Overmoulding

UK First for Injection Overmoulding of Bio-based Composites

- Processibility assessment of injection overmoulding an automotive demonstrator component
- Address industry concern on processibility and performance
- Assess sustainability credentials

Industry Requirements Capture

Materials Down Selection

Processing

Testing

Life Cycle Assessment

Conventional Composites

Non-bio-derived materials which retain value in the economy through **repair, reuse, and recycling**

Glass Fibre /Polypropylene

Bio-Composites

If designed correctly, both fibre and polymer will **biodegrade and regenerate** nature at end of life

Flax Fibre/PLA

Biogas

Manufacturing Capability

We have demonstrated manufacture is viable using the overmoulding process

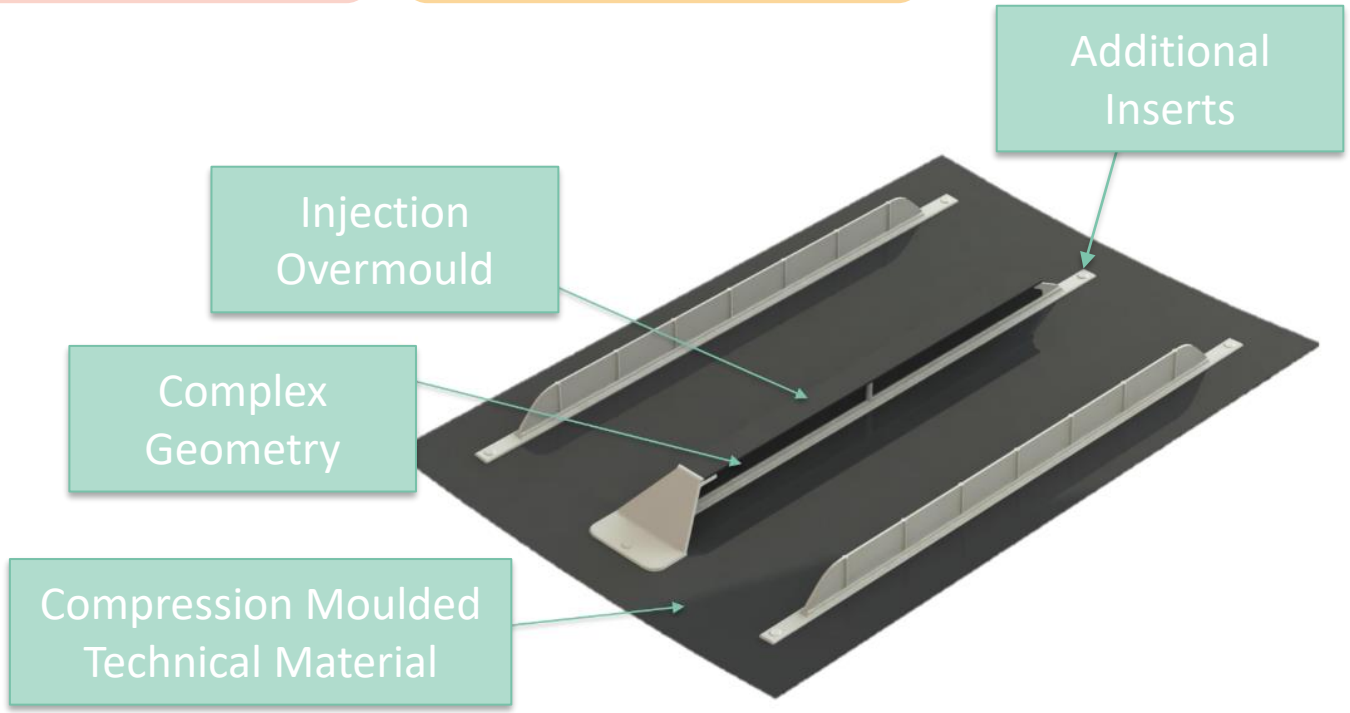
Targets for automotive viability are to manufacture a part…

Under 10 Minutes

Repeatable Quality

Capable of Complex Geometry

- Processing temperatures and pressures were **similar** for both materials
- Flax/PLA benefitted from **longer cooling** time
- **Tool hygiene** was important for high quality parts



In-house Verification

Testing has shown that the right application and design are key when using sustainable materials

Tensile and flexural properties of Flax Fibre/PLA are $< \frac{1}{3}$ of GF/PP

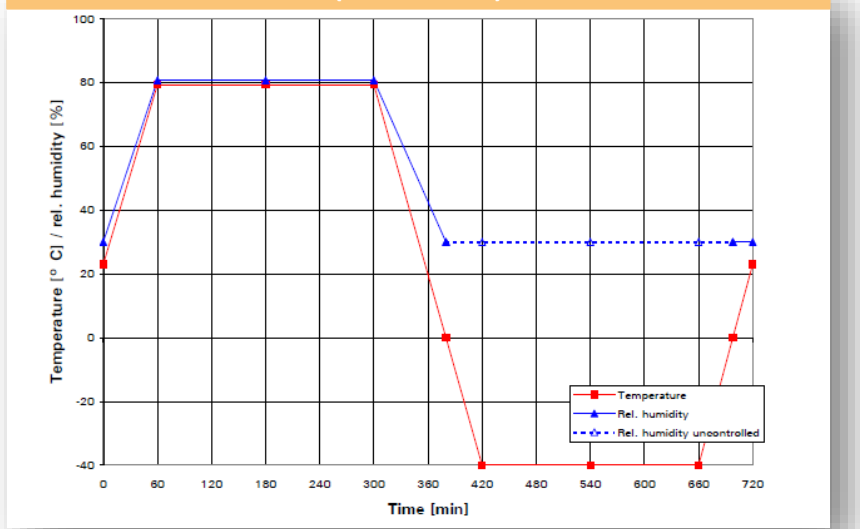
Lower mechanical performance means clever design is needed to boost properties for use in structural applications

Following humidity and temperature tests:

- **Tensile strength** of flax composite reduced by ~ 5% whereas GF composite this reduced by ~10%
- Flax Fibre/PLA **stiffness reduced** by ~50% post conditioning

Reduced environmental performance limits applications in automotive

Temperature and Humidity Cycle (PV1200)



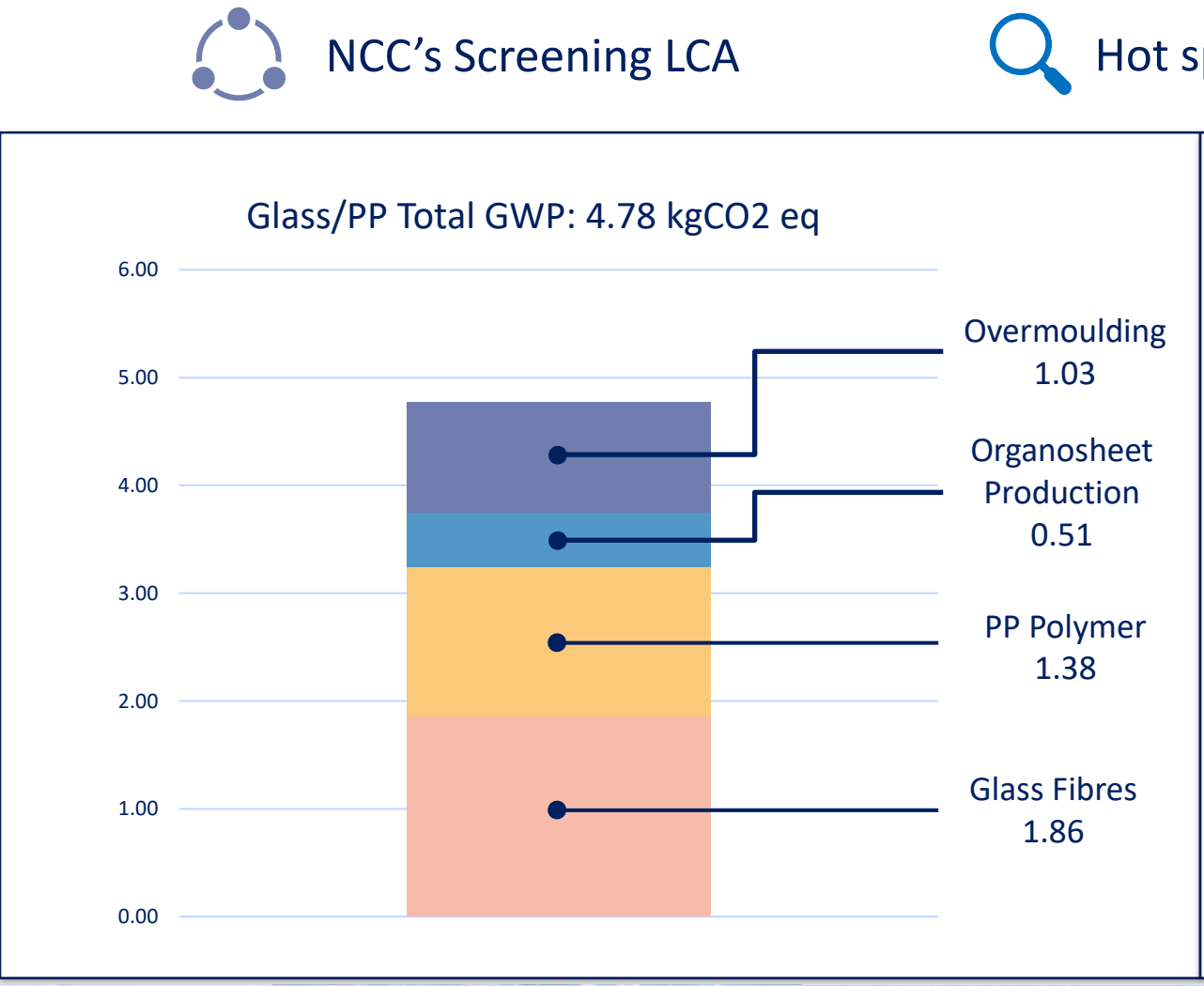
Life Cycle Assessment (LCA)

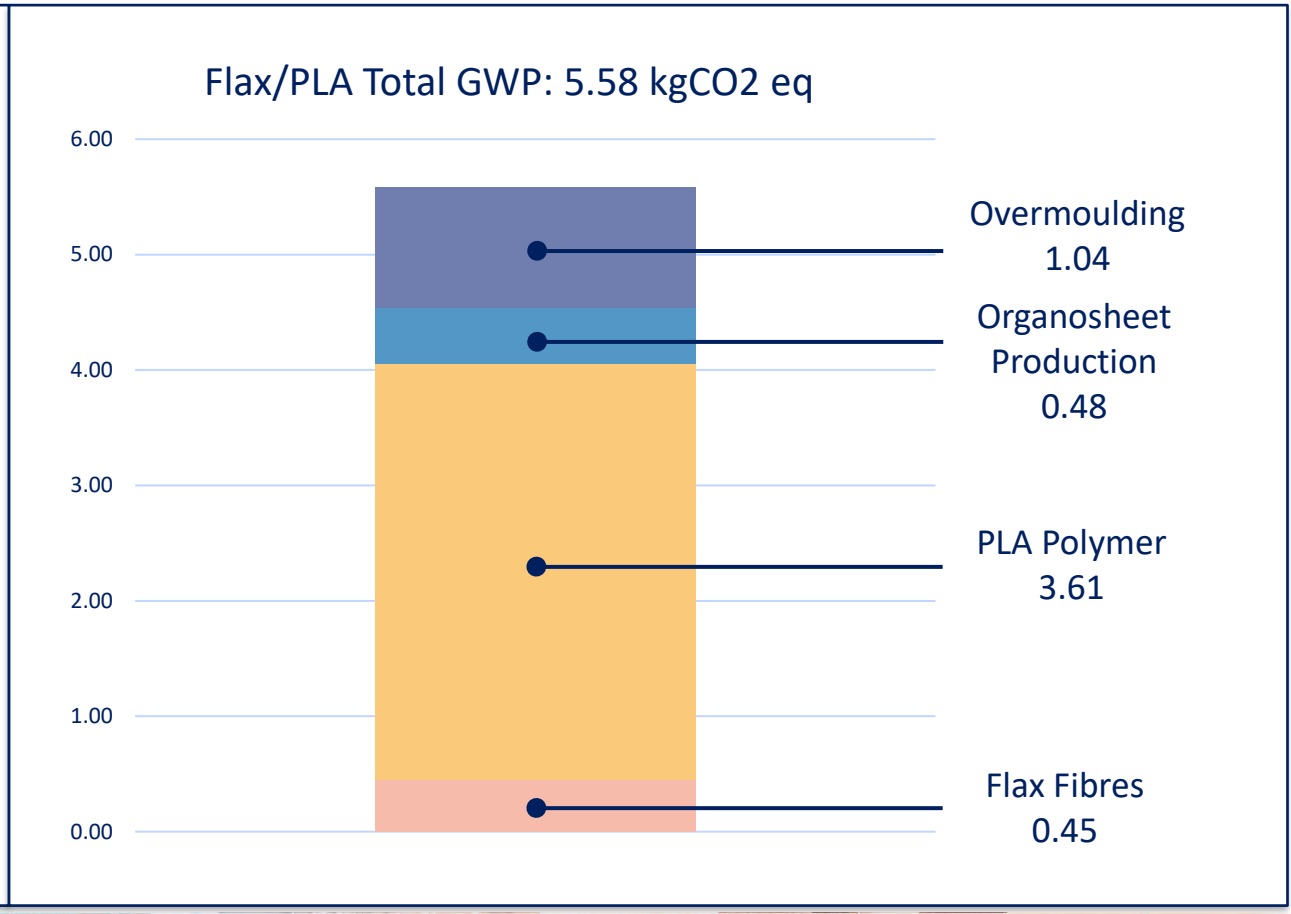
Found improved fibre impact however better-quality data is required

NCC's Screening LCA

Hot spot identification

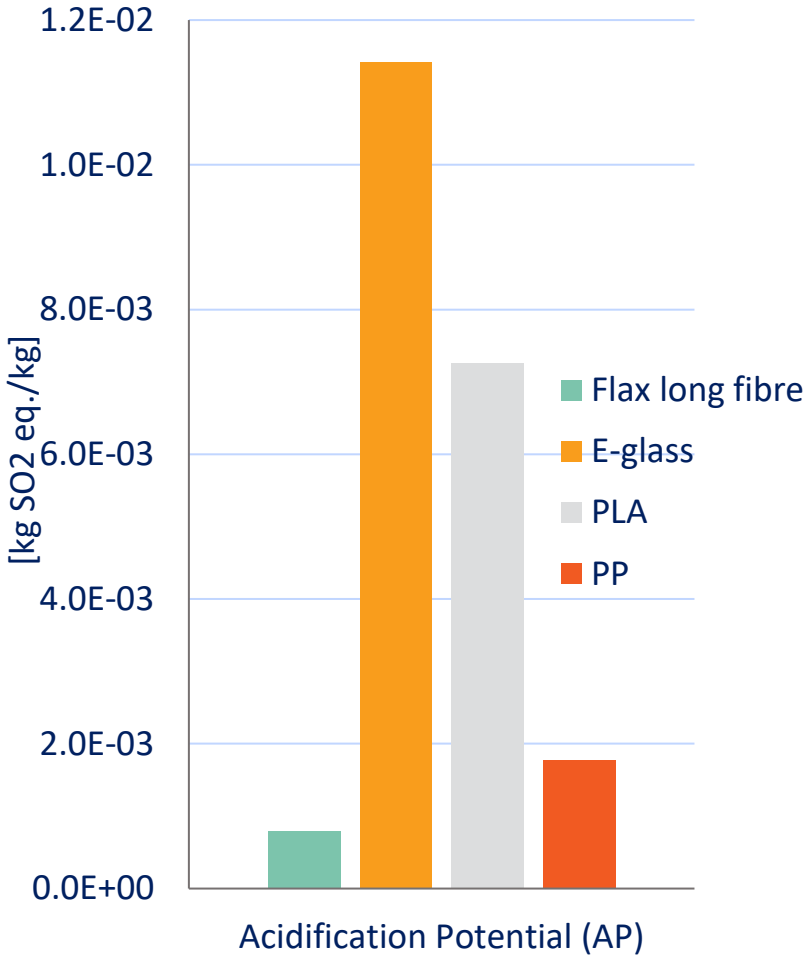
Energy Monitoring



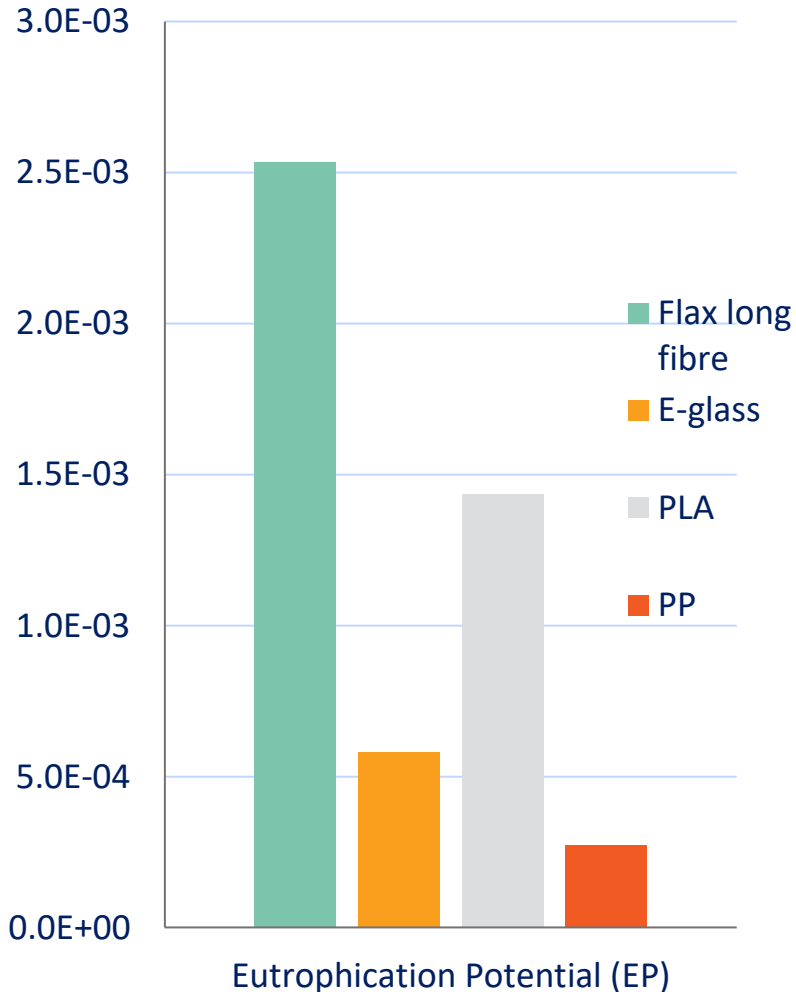


Life Cycle Assessment (LCA)

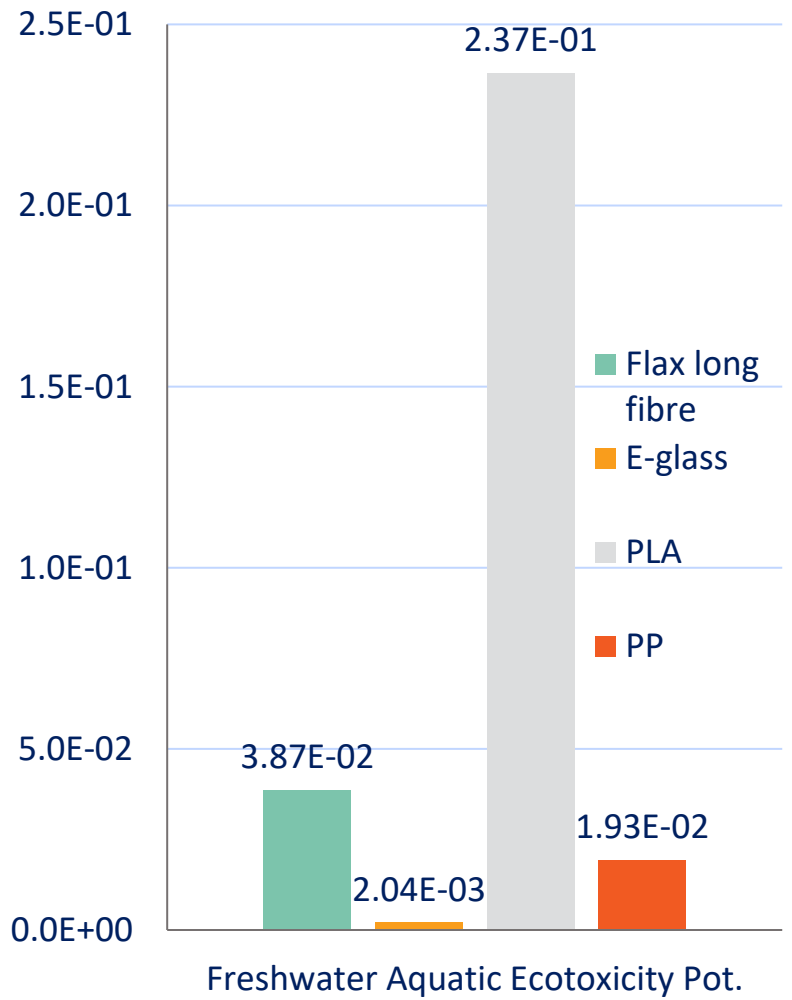
Benefits of natural fibres in GWP must be balanced with other impacts



Acidification Potential (AP)



Eutrophication Potential (EP)



Freshwater Aquatic Ecotoxicity Pot. (FAETP inf.)

Supply Chain

We need more connection across the supply chain

Growers

Determine crop type and quantity and have high impact on environmental impact

Need to know end applications and demand

Formatters

Determines the process and parts fibres can be used in

UK supply chain gap in fibre separation

Material Suppliers

Accessibility of fibres to industry

Need to know properties and variability

End Users

Communicate to growers:

- Demand
- Required crop

Need to know properties, variability, and processing information

Headline Take Aways

Natural fibre composites offer the opportunity for composite materials to come from, and re-enter natural systems in the UK and we have shown they can make parts in high-rate processes. We still need to:

Develop circular polymers

Apply these materials to an in-service part

Understand and model how material **properties vary** and apply to **technical documentation**

Link up the UK supply chain to communicate demand and get quality, UK LCA data

Thank you for your time

Please come and discuss you challenges and opportunities

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