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Characterisation of natural fibres for sustainable composite materials delivered using HiPerDiF

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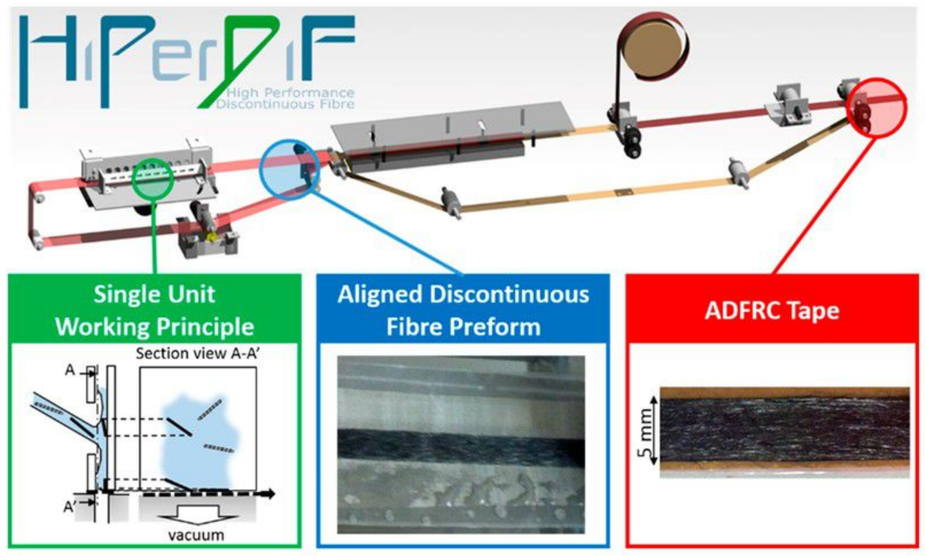
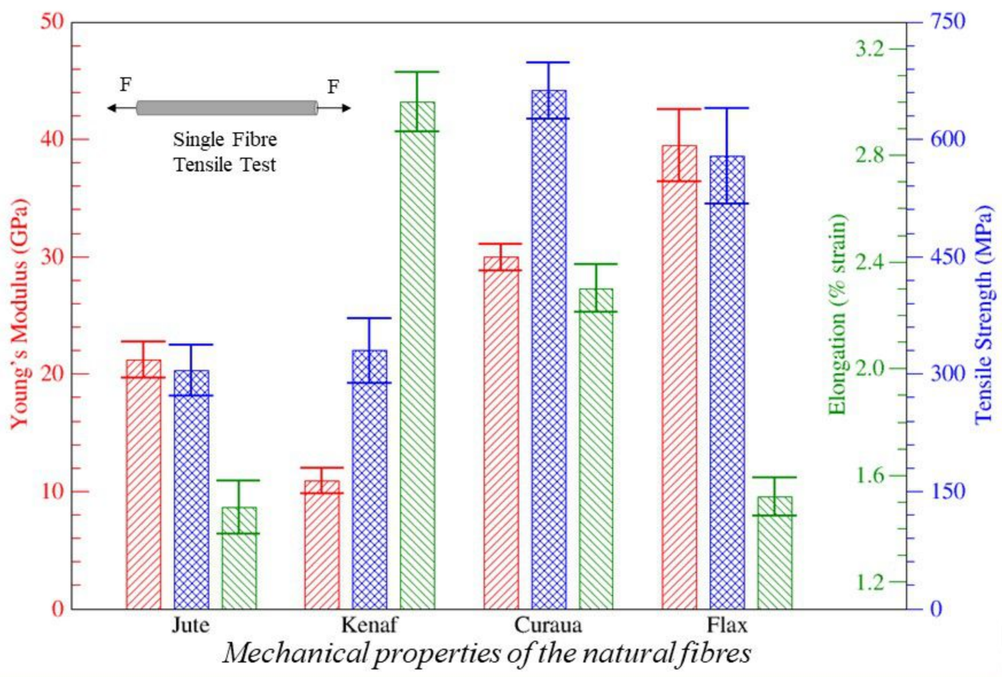
Introduction

Growing environmental concerns and stringent waste-flow regulations make the development of sustainable composites a current industrial necessity. Natural fibres reinforcements are derived from renewable resources, low-cost, manufactured with eco-friendly low hazardous processes and biodegradable. In this study, four types of abundant natural fibres are investigated as a sustainable constituent for high performance composites. Physical, thermal and mechanical properties of the natural fibres are examined to evaluate their suitability as discontinuous reinforcement whilst also, generating a database for material selection. Single fibre tensile and microbond tests were performed to obtain stiffness, strength, elongation, and interfacial shear strengths of the fibres. The critical fibre length was calculated to predict the performance of natural fibres in highly aligned discontinuous fibre composites manufactured with the HiPerDiF technology.

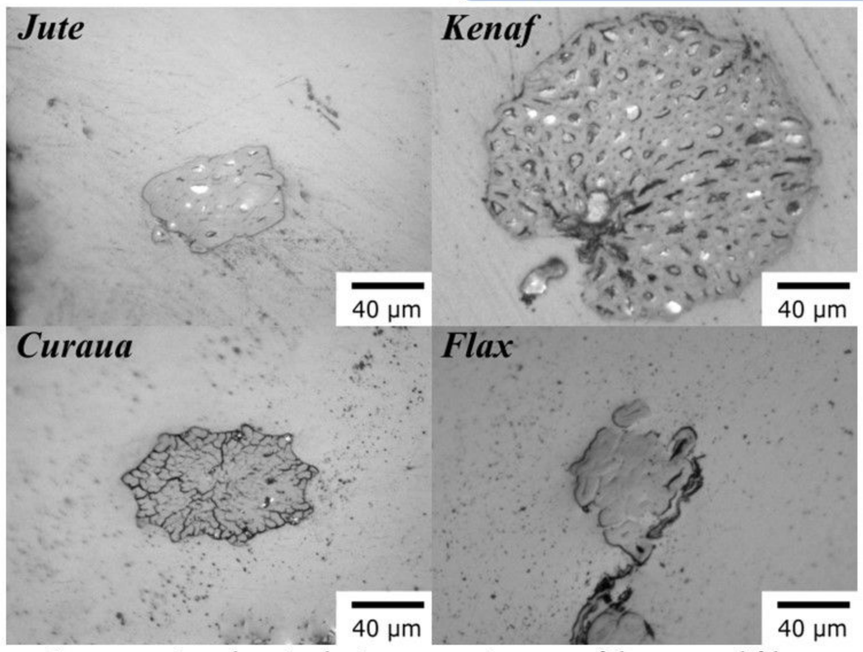


Mechanical Properties

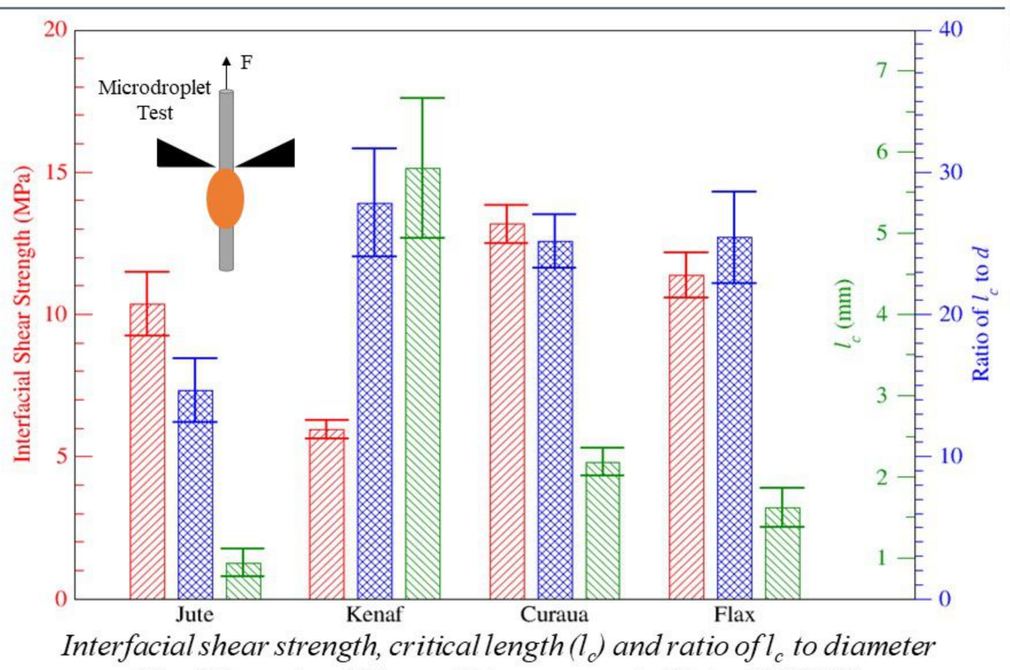


Mechanical properties of the natural fibres

Physical Properties

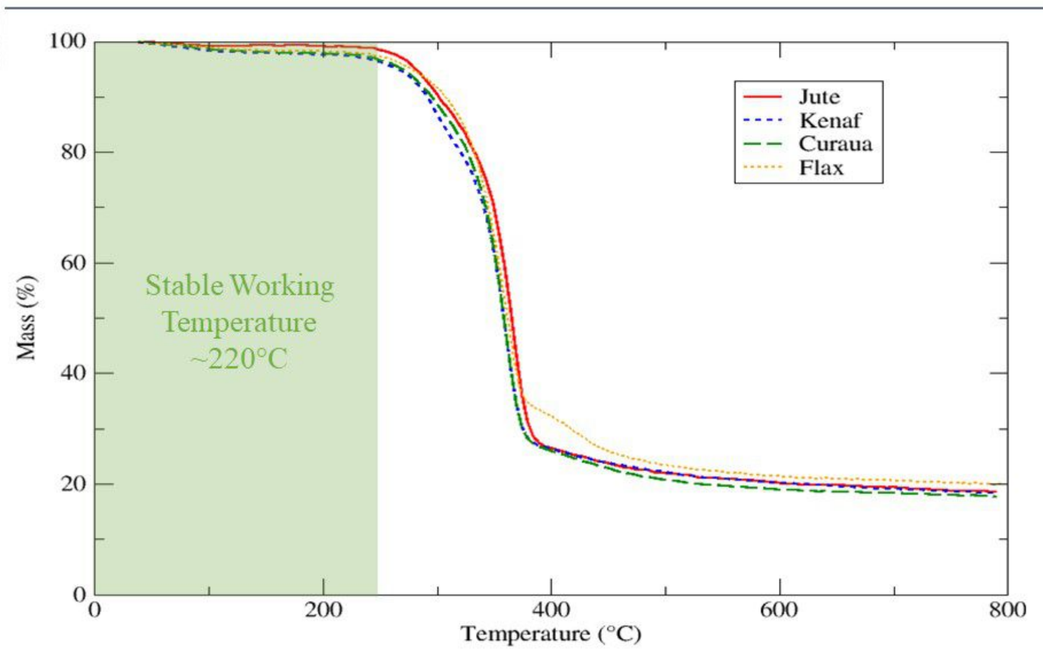


Cross-sectional optical microscope images of the natural fibres



Interfacial shear strength, critical length (l_c) and ratio of l_c to diameter (d) of the natural fibres within epoxy resin (Prime™ 20LV).

Interfacial Properties



Thermogravimetric analyses of the natural fibres.

Thermal Stability

Conclusion

- Curaua and flax fibres are higher mechanical properties compared to other fibres.
- Interfacial shear stress values of the fibres are within 10-15 MPa (except kenaf fibres).
- The critical fibre lengths of the fibres are within 1-2 mm (except kenaf fibres).
- Maximum processing temperature for the fibres is up to 220°C.

Curaua and flax fibres are the most promising reinforcements, and suitable to be processed with the HiPerDiF technology.

Future Work

- The interfacial properties between the natural fibres and sustainable matrices such as thermoplastics and covalently adaptable networks will be investigated.
- Aligned discontinuous fibre composites with combinations of promising constituents will be manufactured with theHiPerDiF technology and characterised.

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