Flax Fibre Thermoplastic Composites: Performance

The ecological advantages of flax fibre reinforced thermoplastic composites make them an attractive alternative to glass fibre reinforced polymer composites whilst having comparable specific properties. In order for these materials to be adopted, we aim to develop natural fibre composites with supreme toughness and impact resistance.

The high cellulose content (65-75 wt%) of flax fibres provides high stiffness (up to 70 GPa) and strength (700 MPa). In addition, thermoplastic matrices are tough and damage tolerant (and in some cases crack blunting or self healing) and offer the possibility of rapid processing.

Within this study, several application specific polymers were identified (stiffness, strength, strain or impact performance driven): polypropylene (PP), poly-L-lactide (PLLA), cellulose derived thermoplastic (Cell_TP), co-polyoxymethylene (coPOM) and epoxy (EP) as a reference.

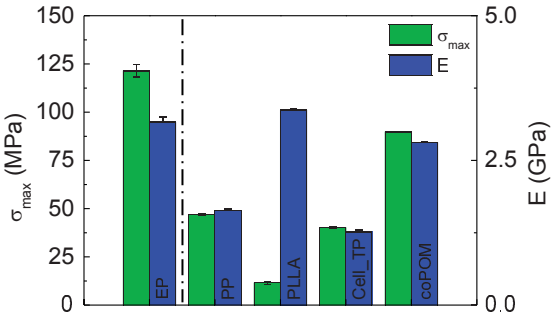

Fig. 1 Flexural properties of the studied matrices

The impact performance of the polymers was evaluated using the ISO 179 Charpy test (Fig. 2). By tuning the polymer (Cell_TP) we may develop impact resistance and lower notch sensitivity.

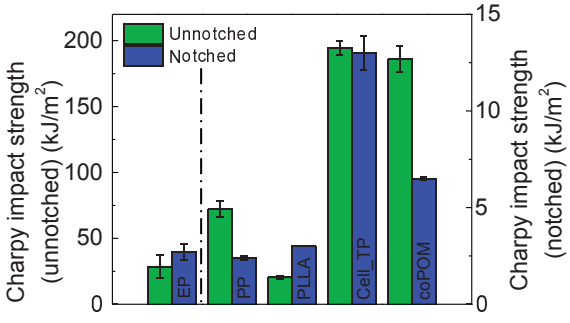

Fig. 2 Charpy impact properties of the studied matrices

The developed composite materials were characterised using longitudinal (Fig. 4) and transverse (Fig. 5) flexure tests. The results are highly dependent on quality of impregnation but show that comparable properties to glass fibre composites may be achieved.

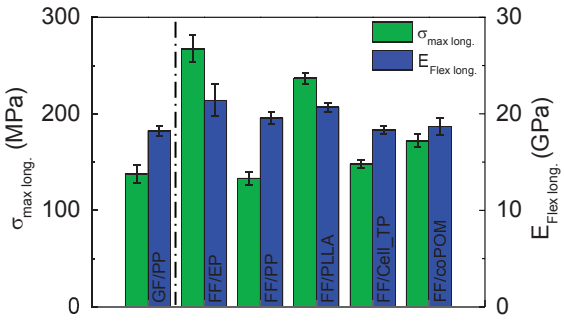

Fig. 4 Specific density, 50% volume fraction normalised flexural longitudinal properties of the flax fibre (FF) and glass fibre (GF) composites

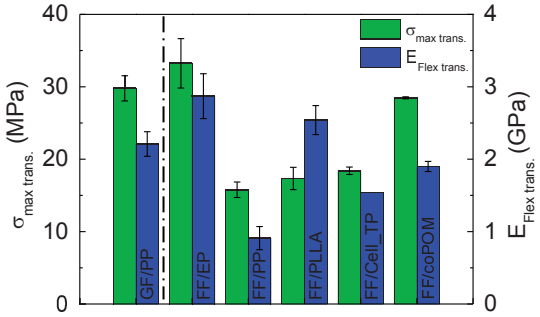

Fig. 5 Specific density, 50% volume fraction normalised flexural transverse properties of the FF and GF composites

Flax fibre composites also suppress vibration efficiently due to their hierarchical microstructure and discontinuous make up. For example, our studies show that the characteristic loss factor is up to 130 % higher than a carbon fibre composite at room temperature. The creep behaviour and environmental effects of the developed natural fibre thermoplastic composites are currently being studied.

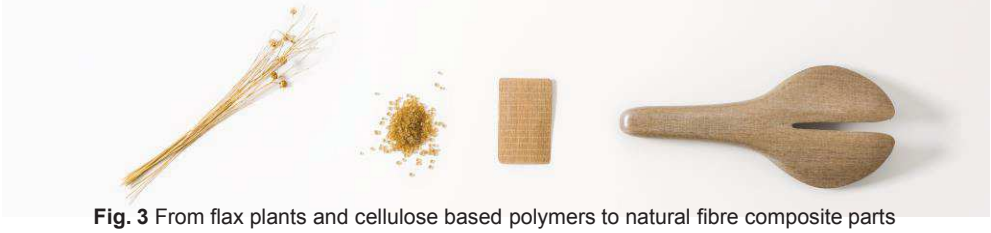

Fig. 3 From flax plants and cellulose based polymers to natural fibre composite parts

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