Optimisation of macro-mechanical properties of flax-fibre-reinforced PP based composites through micro-mechanical studies

Optimisation of Macro-mechanical Properties of Flax-fibre- reinforced PP Based Composites Through Micro-mechanical Studies

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Introduction

The present study is a continuation of the ongoing project to utilise vegetable fibres (e.g. flax) as a reinforcement for composites based on plastic matrices. The objective is to optimise macro-mechanical properties through a micro-mechanical study of flax fibre reinforced polypropylene (PP) based composites. Parameters of interest are flax fibre processing and fibre-matrix interfacial adhesion through addition of coupling agent maleic anhydride grafted polypropylene (MAPP) and processing conditions (effect of trans-crystallinity).

Material and methods

- Single fibre tensile testing.
- Two different methods of application of coupling agent i.e. through fibre coating and matrix modification (blending).
- Study on trans-crystallinity through hot-stage microscope.
- Interfacial shear strength (IFSS) measurements through micro-debond and pull-out tests.
- Tensile testing of macro-composites manufactured through injection moulding.

Results

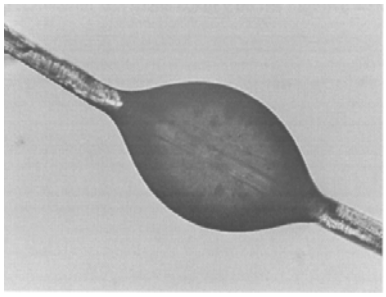

Fig. 1 *A typical micro-debond sample showing a flax fibre with a PP droplet.*

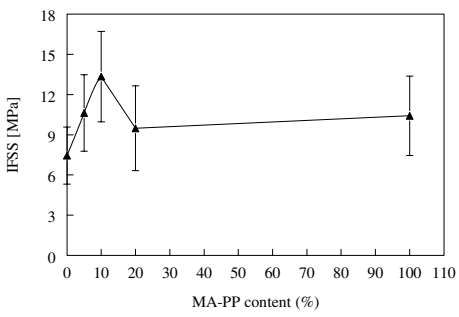

Fig. 2 *Effect of MAPP concentration on the IFSS, of flax/(MA)PP micro-composites, measured through micro-debonding tests.*

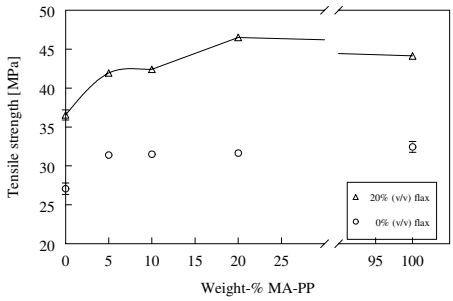

Fig. 3 *Effect of MAPP concentration on the tensile strength of flax/(MA)PP composites manufactured through injection moulding.*

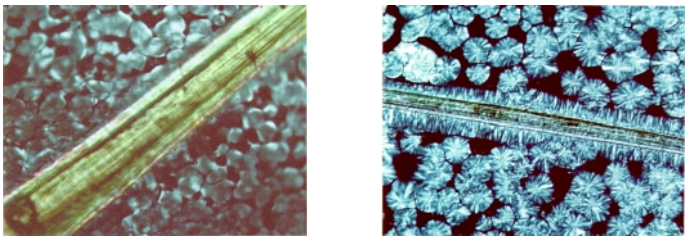

Fig. 4 *An optical picture of PP morphology (observed under a polarised microscope) around Duralin in the case of: (a) a sample quench cooled from 210 °C and (b) a sample cooled from 210 °C to 130 °C at 10 °C/min and crystallised isothermally at 130 °C for 10 minutes.*

Fig. 5 *An optical microscopy picture of microtomed slice taken from the cross-section of a pull-out sample showing the presence of (partial) trans-crystallinity around Duralin flax fibre cells bundle.*

Conclusions

- Matrix modification through blending was more effective than fibre coating.
- Optimal MA-PP concentration for matrix modification.
- Tensile strength of injection moulded composite samples comparable to compression moulded composites inspite of reduction in fibre length.
- No effect of trans-crystallinity on IFSS was observed.