Technical Achievements and Benefits

Development of a radial cell hydro-acoustic process for the clean, high volume production of high quality natural fibres incorporating atmospheric plasma treatment for the SME natural fibre sector.

Project Facts

Contract No. FP7-243456
Starting date: 1st January 2010
Duration: 36 months
Project Website: http://www.ultrafibre.org
EU Funding: €1,742,245
Project Coordinator: Mr Girolamo Dagostino

Assocomaplast
www.assocomaplast.org

BPF
www.bpf.co.uk

EIHA
www.eiha.org

AcXys
www.acxys.com

Movevirgo
www.movevirgo.co.uk

ICMA
www.icmasangiorgio.it

K.E.F.I.
www.kenaf-fiber.com

Ekotex
www.ekotex.com.pl

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Trade Associations

Assocomaplast
www.assocomaplast.org

BPF
www.bpf.co.uk

EIHA
www.eiha.org

Research Partners

Smithers Rapra
www.rapra.net

In Control
Ultrasoundics Ltd
www.ffr-ultrasonics.co.uk

Wageningen UR
www.fbr.wur.nl

Greengran
www.greengran.com

Industrial Companies

AcXys
www.acxys.com

Movevirgo
www.movevirgo.co.uk

ICMA
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Introduction

Fibre reinforced polymers find wide commercial application in the aerospace, leisure, automotive, construction and sporting industries. In recent years there has been much interest in developing natural fibre reinforced polymers for a sustainable substitution of synthetic materials, and also to develop markets for the European non-food crop industry sector.

The UltraFibre project will deliver a scalable, economic, continuous, clean- fluidsonics technology to produce high quality fibre, conferring:

- Competitive production costs
- High quality elementary natural fibres
- Higher quality commercial thermoplastic and thermosetting composites in targeted end-user applications
- Integration of a Soft Plasma fibre treatment process with the aim of conferring a 25% increase in mechanical properties compared with the untreated fibre

Methodology

UltraFibre brings together industrial companies (SMEs), trade associations (IAGs) and research partners from the development consortium spread across the EU. Initial stages of the project have been carried out by research partners to develop the processing equipment. The results of this study will be scaled-up to an industrial process.

The trade associations are responsible for disseminating this knowledge base for the benefits of SMEs throughout the plastic and natural fibre supply chain across the EU.

Figure 1 shows the volume distribution of fibre diameter. Sonicating the fibres in conjunction with a caustic pre-treatment increases elemental fibre content from 40% to 80%. This affords a greater and cleaner surface area for plasma treatment and therefore a better adhesion to the polymer matrix is expected, thus increasing the mechanical properties of the composite.

Different fibre (Flax and hemp) iterations were compounded with 5% MAPP/PP on a 21mm twin screw, the 30% fibre PP composite was injection moulded into test bars and tested for flexural modulus, flexural strength and Charpy impact.

Atmospheric plasma treatment of natural fibres results in an increase of mechanical properties in their composites. Flax-PP composite flexural strength increases by 23%, close to the improvement by using 1% MAPP (Figure 3). Plasma treated flax-1% MAPP performs similar to untreated flax-3% MAPP, thus reducing the required amount of expensive MAPP significantly. Flexural strength of plasma treated Hemp-PLA composites increases by 20-24% compared to the untreated reference fibre (Figure 4).

Summary of Benefits

- A flow through ultrasonic processor unit was developed.
- The ultrasound treatment removes surface contaminants:
  - consequently reduces fibre bundles to elemental fibres with clean surfaces
  - for enhanced adhesion prior to plasma treatment.
- Plasma treatment of natural fibres results in an increase of mechanical properties of their composites, in particular:
  - Flax-PP flexural strength increases by 23% by using 1% MAPP.
  - N₂ treated flax-1% MAPP performs similar to untreated flax-3% MAPP.
  - Hemp-PP flexural modulus increases by 11-22%, similar to and more than achieved by using 1 or 3% MAPP (8 and 11% increase in modulus).
  - Hemp-PLA flexural strength increases by 20-24%.
  - Charpy impact strength is not significantly affected.