BioStruct

NEWSletter

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Natural fibre reinforcement for enhanced products

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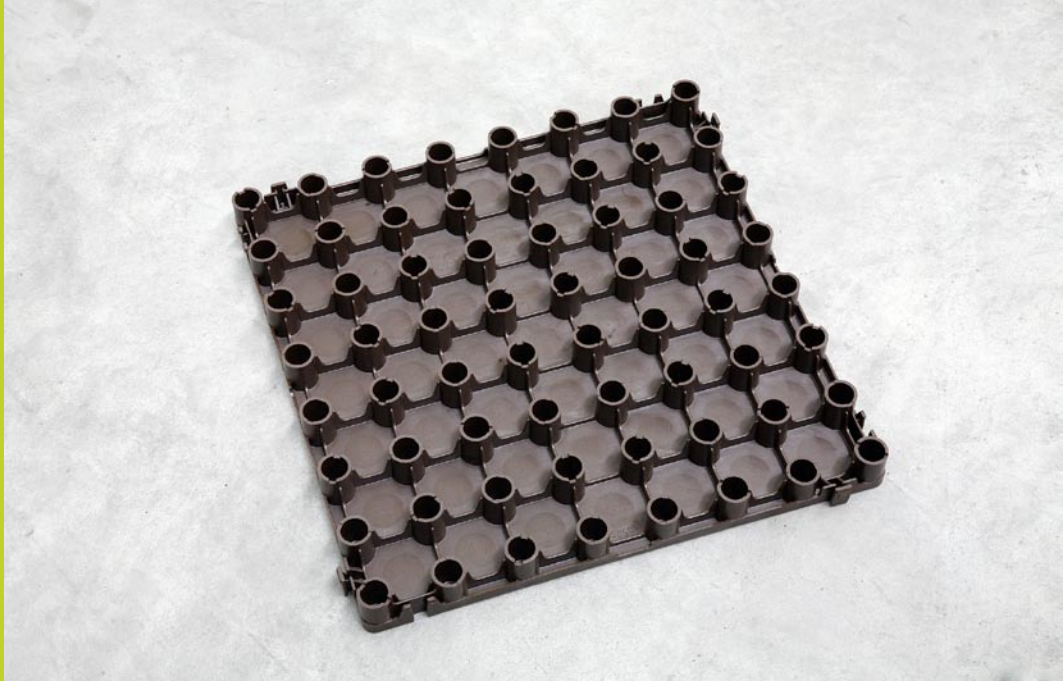
First BioStruct training event took place on February 16th 2011 in Pfinztal at the Fraunhofer ICT

- State-of-the-Art in Bio-Composities
- Compounding of Bio-Composities
- Processing of Bio-Composities
- Properties of BioStruct Materials



Project overview

BioStruct is a large-scale collaborative project funded by the European Commission. The project involves 21 partners from 10 European countries, and has a total budget of around 10 million €. The project is planned for a total duration of 48 months, and started in September 2008. BioStruct aims to develop the next generation of wood and cellulose-reinforced composites - so-called „enhanced wood-plastic composites" or eWPCs - for complex structural and multifunctional components.

The project was set up to overcome the most important problems in the application of reinforced bio-composites by combining material development and process development in an integrated approach. In close collaboration with polymer, fibre and additive producers, compounders within the consortium have developed new material formulations to fit end-user requirements from four different industrial sectors: automotive, construction, electronics and packaging. In parallel, process developers are optimising and adapting injection moulding as well as extrusion technology to process these new materials under optimum conditions with the highest possible production rate.

Wood fibres
- physical-mechanical-treatment
- pretreatment
- grafting
- extraction

Cellulose fibres
- screening of fibres
- grafting
- functionalisation
- modification
- precipitation
- characterisation

Bio-matrix
- bio-based matrix
- modified PLA
- bio-based additive systems

BioStruct: Material development Process development **eWPC building blocks**

Compounding
- integrated processes
- planetary extrusion
- reactive modification

Shaping
- 2-component sandwich-moulding
- tailored reinforcement coextrusion

Foaming
- coextrusion/foam core
- foam injection molding
- particle foam technology

4 case studies
- automotive
- construction
- electronics
- packaging

Over the past 24 months since the start of the project, the BioStruct consortium has developed interesting material solutions. In the area of matrix materials, development work was mainly focussed on the synthesis of new bio-based polyamide systems. Starting from conventional hot-melt systems, new polymers were developed with reduced tack, drastically improved e-modulus and better flow properties. Reinforced with fibres, they show interesting mechanical properties combining stiffness and high impact strength, even at lower temperatures.

In order to achieve higher mechanical stiffness for engineering applications with an e-modulus above 3000, fibre reinforcement is necessary. BioStruct is developing new polymer-compatible fibres based on wood fibres obtained for example from the paper industry or from cellulose regeneration processes well known in the textile industry. Key areas of activity are to improve the fibre matrix interaction and to solve the dosing problems commonly associated with these types of fibres. Fibre treatments to improve polymer compatibility have been developed for conventional polymers such as PP as well as for bio-polymers like PLA or bio-based PA.

In the area of processing, development work started later in the project, enabling the partners involved to work with the newly developed materials. Adapted compounding processes have successfully been developed to process temperature-sensitive polymers at the lowest possible temperatures and apply only the necessary dispersive energy input to distribute fibres without extensive fibre breakage. For later commercial injection moulding of bio-composites high output rates, fast cycle times and safe and continuous processing are extremely important.

BioStruct is developing new plastification processes for the new material; which combine high plastification rates with low material stresses. At the same time, new mould technology is being developed to locally reinforce injection-moulded parts, generating very high mechanical properties in certain regions of the moulded part. In extrusion technology, profiles will be developed that combine surface functionality with stiff base materials and a foamed core, delivering good damping and insulation properties in combination with good flame retardancy.

The end-users involved in the BioStruct project have a clear exploitation strategy to utilise the new bio-composites in their products in the near future. Initial development samples of beer crates, automotive parts, logistics equipment and samples for the electronic industry have been produced, both to demonstrate the achievements of BioStruct in the area of material development and processing, and to help to focus development work in the second half of the project.

TENCEL® FCP
Natural fibre reinforcement for enhanced products

Sustainability, bio based polymers and renewable raw materials, these are currently main topics in the plastic industries. Not only driven by increasing prices of crude oil, but also to reduce energy consumption and the carbon footprint, many polymer manufacturer as well as the whole plastic industry is looking for appropriate solutions.

Up to now mainly glass fibres have been used to reinforce plastic structures. Easy handling and dosing, good dispersion and a constant diameter resulting in constant mechanical properties throughout the composite, as well as resistance to elevated temperature have made this mineral fibre to the fist choice of manufacturer. While being sustainable alternative traditional natural fibres (like hemp or flax), they often do not reach the requirements of the properties just described. These limiting factors have caused the minor role of natural fibres in the plastic industries.

However Lenzing has put a lot of efforts into developing a sustainable fibre, that overcomes the above mentioned issues. Mechanical properties of natural fibres are influenced by factors like harvesting, kink bands, climate and growth condition. The raw material for TENCEL® FCP is wood, which is transformed into a fibre of pure cellulose in an economy friendly process. As a matter of fact all above mentioned limiting factors of natural fibres are eliminated. On removing lignin and all the other by-products TENCEL® FCP has a significantly higher temperature resistance compared to other natural fibres.

The composite properties are highly dependent on parameters, like mechanical fibre properties, fibre diameter, quality of fibres dispersion, and fibre matrix adhesion. Keeping them constant throughout the whole composite part is the factor to success. TENCEL® FCP, a man made cellulosic fibre, fulfils all those requirements. The diameter as well as the mechanical properties of the fibres are kept within a very narrow range thanks to the unique manufacturing process. Lenzing's engineers have also developed a unique surface modification, guaranteeing a high quality of dispersion. Being modified this way TENCEL® FCP can be use on standard dosing equipment.

Figure 1 shows the tensile improvement of PP by using different quantities of TENCEL® FCP.

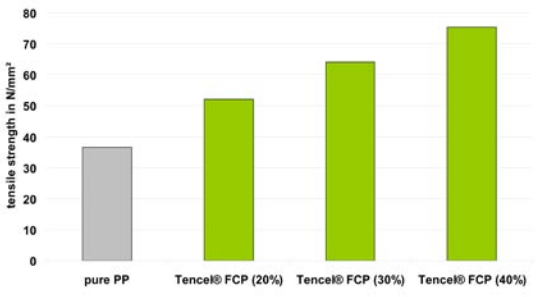
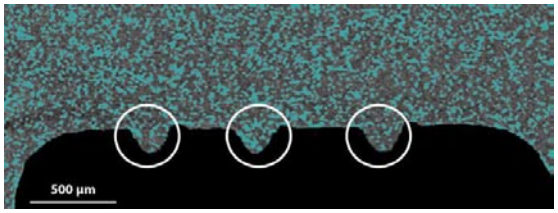


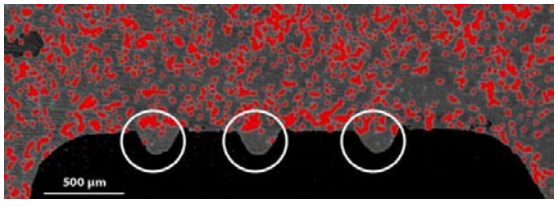
Figure1: tensile strength PP/TENCEL® FCP at different fibre load

A significant improvement by a factor of 2 can be observed. Similar results are achieved for tensile modulus, as well as energy absorption during impact testing. (e.g. Charpy notched impact strength).

TENCEL® FCP has the ability to reinforce even areas, which other fibres like glass fibres can not reach. This opens the possibility of reinforcing thinnest walled areas as well as very small parts. A comparison of both is shown in the x-ray-computer tomography picture 1 and picture 2 (courtesy of FH Wels, Austria).



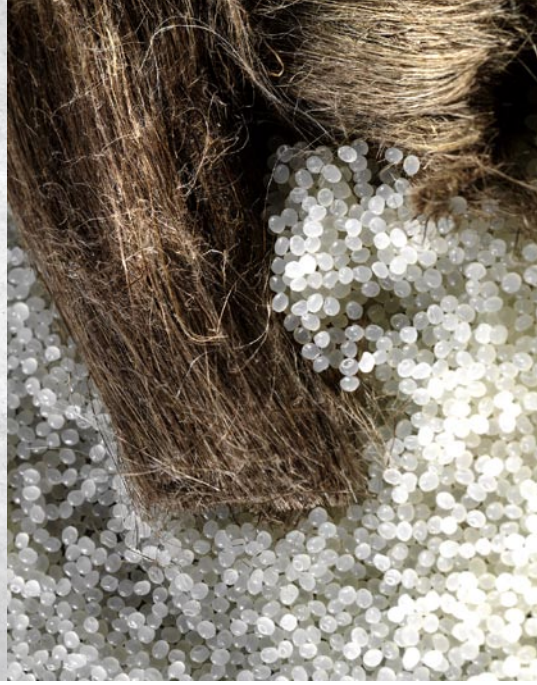
Picture 1: CT of a TENCEL® FCP / PP part



Picture 2: CT of a glass fiber / PP part

Sumary:

TENCEL® FCP is a sustainable natural reinforcement fibre providing a unique property profile. Made from wood in an environmentally friendly process it shows enhanced reinforcement properties in the area of tensile strength, modulus as well as in impact behaviour. Process suitability has been highly improved by surface modification allowing to use common dosing equipment. By removing all by-products the temperature resistant has been increased compared to other lignocellulosic fibres.



First BioStruct training event took place on February 16th 2011 in Pfinztal at the Fraunhofer ICT

The first BioStruct training event took place on February 16th 2011 in Pfinztal, Germany at the Fraunhofer ICT site. The event saw a turnout close to 40 partners and external participants.

The topic of the training event was "Processing and Properties of Bio-Composites" and four speakers from the BioStruct gave presentations on the following topics; State-of-the-Art in Bio-Composities (Lars Ziegler, Tecnaro), Compounding of Bio-Composities (Jan Diemert, ICT), Processing of Bio-Composities (Gerhard Bäck, Engel), and Properties of BioStruct Materials (Katja Klophaus, Henkel).

After each presentation a series of questions and answers followed which highlighted the interest in BioStruct technologies . Jan Diemert as coordinator for the BioStruct Project then gave an outlook on the project consisting of where the project is at, its results so far and the next steps that need to be taken to bring the results to the market. Strong interest was shown by external participants in the BioStruct materials and processes and the BioStruct Project and its partners shall build on this throughout the remaining duration of the project.

The presentations from this first training event can be found on the BioStruct projects' website www.biostructproject.eu.

In the framework of the project a more elaborated training material has been developed. This training material is split into different modules explaining the BioStruct materials, material properties and process technologies. Furthermore, an overview of the implementation by various case-studies is shown as well as a summary of the ecological, economic and health impact of the projects developments.

The complete training material can be downloaded from the projects website (www.biostructproject.eu) and shall be updated with the latest results of the case-studies by the end of the project in October 2012.

The next BioStruct training event will be on "Bio-fibres and their Processing" which will take place on June 7th 2011 at the VTT premises in Jyväskylä, Finland. This event will be open to all interested parties and attendance will be free of charge. The BioStruct consortium look forward to welcoming you at this second training event and encourage you to invite all parties who may be interested in attending this event. More information can be found on the BioStruct projects' website www.biostructproject.eu/index.php?id=training.

First BioStruct training event – State-of-the-Art in Bio-Composities

Dr. Ziegler graduated in Mechanical Engineering and received his PhD in Chemical Engineering on the topic of Innovation Management, at the University of Stuttgart. In the past he has worked for 13 years at Fraunhofer ICT in the area of Polymer Engineering and General Management., including two years in the United States and two years in Brazil where he was involved in the development of bio-based compounds, plastics processing and mould technology. Today, he is director for R&D and Innovation Management at Tecnaro. Tecnaro is involved in current projects at the European and national level relating to bio-composites, biodegradable compounds for packaging, automotive, toys and other applications. Dr. Ziegler brings to the BioStruct project, his expertise in the area of developing bio-based technical compounds and their processing, including compounding and injection moulding.

When asked how he felt the BioStruct project was developing, Dr. Ziegler stated the following;
"In the BioStruct project we have already achieved very good results regarding the improvement of impact strength of biopolymers. We hope that the research partners will achieve their objectives regarding fibre modification which could then be used in our Biocomposites as well."

Picture: Dr. Lars Ziegler, Tecnaro GmbH, Ilsfeld, Germany, Director R&D, Innovation Management

First BioStruct training event – Compounding of Bio-Composities

Picture: Jan Diemert , Fraunhofer ICT, Pfinztal, Germany
Deputy Director of the Department of Polymer-Engineering

Jan studied Mechanical Engineering at the Technical University of Aachen and specialized in polymer processing during his studies at IKV (1991-1997). Since 1998 he has been working in the department for Polymer-Engineering at the Fraunhofer Institute for Chemical Technology (ICT), mainly in the area of thermoplastic materials processing.

Since 2000 he was working in compounding and extrusion activities and actively built up the compounding lab, which runs as many as 6 twin-screw-extruders. Since 2001 he is leading the group of injection moulding and extrusion.
In 2003, Jan achieved his doctoral degree at the University of Stuttgart with his work on "Fundamentals of Plasticizing polyvinylchloride with microwaves". Following this he was appointed Deputy Director of the department for Polymer-Engineering, which employs close to 90 people in a broad range of polymer processing topics.
Since 2008 Jan is coordinating a large European Integrated Project, which aims at the development of the next generation of wood-polymer-compounds processing.

Today Jan has more than 8 years of experience in compounding of thermoplastic materials and twin-screw-compounding process development. Special areas of interest to him include; integrated processes, which for example use alternative energy sources (e.g. microwave, ultrasonic energy) or which use CO_2 as extraction agents.

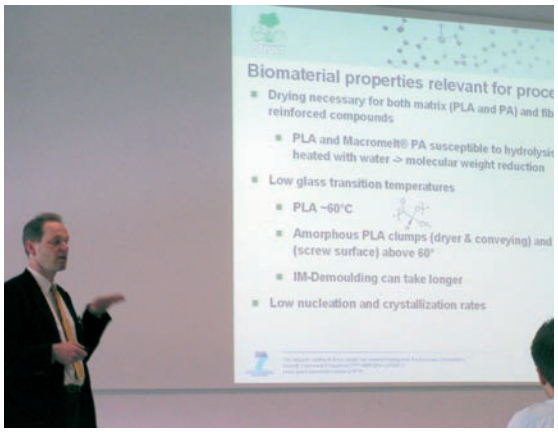
His expertise is thus related to the area of compounding and thermoplastic material processing. In BioStruct the focus is on the development of innovative ways to compound and inject bio-composites.
When asked how he felt the BioStruct Project was going, Jan stated that it is going very well indeed. "BioStruct is a very active project, which has already produced some very innovative applications and materials. The training event showed a strong interest in our materials, processes and technologies."

First BioStruct training event – Processing of Bio-Composities

Mr. Bäck holds a degree in Polymer Engineering from the University of Leoben, Austria. After graduating, he became a university assistant at the Institute for Materials Science and Testing of Polymers in Leoben. Following his time at this Institute, Gerhard completed his civil service in 1997 and held the position of Project leader at Joanneum Research, A-Graz. In 1998 he became project leader for production with Lenzing until joining Engel in 2003.

Mr. Bäck's area of expertise is that of screw development for biomaterials, integrated direct manufacturing and injection moulding case studies.

"Our BioStruct project brings together partners from wood and fiber industry, raw material manufacturers, machine manufacturers, mold makers and producers from all over Europe. This broad approach is definitely necessary to make the best out of biopolymers and shift their properties to higher levels. Travelling across Europe is time consuming, but the numerous results are worth the effort."



Picture: Gerhard Bäck, Engel Large Machinery Plant, Saint Valentine Technology Manager

First BioStruct training event – Properties of BioStruct Materials

Picture: Katja Klophaus, Henkel Corporation, Dusseldorf, Germany
Project Manager, R&D Hotmelts-Polyamides

Ms. Klophaus is a graduate of the University of Applied Science, Bonn-Rhein-Sieg, where she earned her Diplom-Chemikerin. After graduating in 2005, Katja joined Henkel as Project Manager in Research and Development Hotmelts-Polyamides. Henkel is a world-wide supplier of adhesives where hotmelts like polyamides are seen as one of the most important technologies. The focus of Henkels research areas is that of projects covering the future demands in our key markets like automotive, electronics, packaging and power generation.
Within Biostruct, a new generation of polyamides based on renewable resources for the use as polymer matrix, has been developed. The product series of Macromelt ® MM700x shows low process temperatures, an outstanding impact behavior and a good fiber matrix adhesion to natural fibers. This performance makes it an ideal candidate for the production of "green" composites with a bio-based matrix and natural fibers as reinforcement. The technology of manufacture composites by extrusion and injection molding "opens new markets for low performance and high volume parts."

Kathja believes that the BioStruct project couldn't come at a better time as the demand for "green" composites with specific mechanical properties has increased in the last few years. The Biostruct collaboration network follows this trend and gives new possibilities to generate sustainable composites in temperature sensitive processes and for low performance applications. "We have already achieved promising results to improve WPC´s."

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