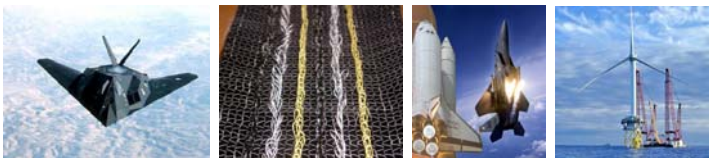
ICCM17 Edinburgh
27-31 July 2009, Edinburgh, UK



Natural Fibre Composites

Why are Natural Fibres Failing to Deliver on Composite Performance?
J Thomason (Univ of Strathclyde)
We discuss the poor performance of natural fibres as composite reinforcements where the focus on chemical aspects has not yet delivered the "holy grail" of glass fibre replacement in volume applications. We propose an explanation based on the anisotropic structure of these fibres and its influence the composite interphase. **(D9:1)**

Interfacial Studies of Polylactic Acid (PLA)/Flax Biocomposite: From Model Surface to Fibre Treatment
G Raj, E Balnois, C Baley, Y Grohens (LIMATB)
Interfacial interactions in flax/PLA biocomposite were directly measured by approaching a cellulose colloidal probe to a polylactic acid surface, using an atomic force microscope. A NaOH treatment on flax fibres was then proposed and optimised to improve the interfacial adhesion between the two components. **(D9:2)**

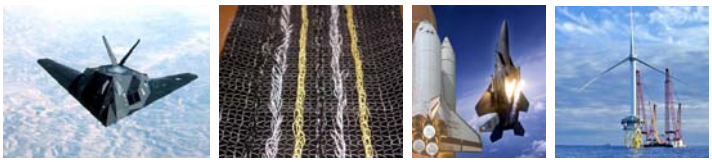
Study of Interfacial Bonding of Flax/Poly(L-Lactide)
A le Duigou, C Baley (LIMATB) P Davies (IFREMER)
Vegetal fibre reinforced biopolymers called biocomposites are an alternative to the glass fibre reinforced thermoset composites used today in marine applications. The purpose of this article is to understand their interface phenomena and to compare flax/PLLA with others composites using microbond tests. **(D9:3)**

Cellulosic Nanocomposite Prepared by Acetylation of Bacterial Cellulose using Supercritical Carbon Dioxide
M Suetsugu, T Nishino, M Kotera (Kobe Univ)
The surface of bacterial cellulose (BC) nanofibers was acetylated under supercritical carbon dioxide (sc-CO2) condition without using organic solvent. The BC nanofibers, with their surface selectively acetylated, were compression molded into the composite. This new type all-cellulose composite was found to possess high optical transparency, mechanical properties and heat resistance. **(D9:4)**

Electron-Beam Irradiation of Recycled Newspaper Filled Polypropylene/ Natural Rubber Composites: Effect of Crosslink Promoters
H Osman, H Ismail, M Mariatti (Univ Sains Malaysia)
The effect of crosslink promoters on electron-beam irradiation of recycled newspaper filled polypropylene/ natural rubber composites were studied. **(D9:5)**

Characterization of Viscoelastic Properties of Flax Reinforced Polypropylene Composites
M John, R Anandjiwala (CSIR)
This paper deals with the investigation of dynamic mechanical and thermal properties of flax nonwovens reinforced polypropylene composites. The effect of zein as a coating on flax fibres and its influence on the interfacial mechanism between fibre and matrix was also analyzed. Reinforcement was found to increase the storage modulus and thermal stability of composites. **(D9:6)**

Effects of Microstructure of Natural Fibers on the Interfacial Properties of their Composites
Y Li, F Lv, Y Luo, W Zhang, W Gan (Tongji Univ)
Microstructures of natural fibers after fiber surface treatments and moisture absorption were revealed. Single fiber pull-out test and short beam shear test were employed to study the interfacial properties of the composites. It was concluded that the interfacial properties of natural fiber composites are strongly dependent on the microstructures of natural fibers. **(D9:7)**



Hierarchical Structure and Mechanical Properties of Bamboo Fibrils
FK Ko, YQ Wan (Univ of British Columbia)
Bamboo is a rich source of renewable cellulose. It has many outstanding specific properties such as good mechanical properties, bacterial resistant properties etc. Bamboo fibrils are the structural building block of bamboos. Understanding of the structure and the properties of the fibrils at various structural levels will not only shed light on nature's secret of efficient design of structural composites but also inspires creativities. **(D9:8)**

Recycle of Polyester/Cotton Mixed Yarn as Rainforcement of Hybrid Composite Material
T Kimura, H Hanamitsu (KIT)
Compression molding of hybrid composites by using the waste of Pet/Cotton mixed yarn as reinforcement was carried out and the mechanical properties of molded composites were discussed. As a result, the fairly high strength, modulus and Izod impact value could be obtained for the molded hybrid composites with PP matrix. **(D9:9)**

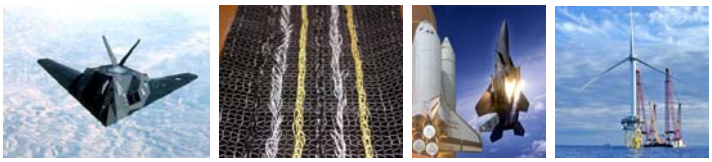
Compression Molding of Green Composite Made of Wood Shavings
S Nonaka, T Kimura (KIT)
The purpose of this study is to develop a green composite using only wood material. Wood shavings are used in this board. The shape of wood shavings are mainly in a linear form. In order to compress these linear materials, an intricate structure board can be produced. Moreover, board made by longer shavings has higher mechanical properties. **(D9:10)**

Development of Abaca/Furan Green Composites
T Tumolva, M Kubouchi, T Sakai (Tokyo Institute of Tech)
The mechanical performance of continuous abaca fiber-reinforced furan-based green composites was evaluated. Alkali treatment was done to improve fiber-matrix adhesion, and the fiber sheets were combined with furan by hand lay-up method. The composite's strength was then measured and morphological study of the fracture surface was done. **(D9:11)**

Thermomechanical Evaluation of Sisal-PLA Composites
M Prajer, MP Ansell (Univ of Bath)
Sisal fibre-PLA composites were prepared by film stacking and compression moulding for Vf up to 0.6. Flexural strengths of over 250 MPa were achieved and using DMTA the glass transition temperature (Tg) was seen to fall as Vf increased. Hot stage digital microscopy was used to follow spherulitic crystal growth of PLA on sisal fibre bundles. **(D9:12)**

Next Generation Sustainable Composites: Development and Processing of Furan-Flax Biocomposites
E Arnold, B Waeger (NetComposites) H Hoydonckx (TransFurans Chemicals) B Madsen (TU Denmark)
The work presented in this paper was undertaken as part of BIOCOMP (2005-2008), a European collaborative project, which developed new classes of engineering composite materials from renewable resources. Comprising twenty five European SMEs and research organisations, this three and a half year project generated a wide range of new biocomposite materials, knowledge-based processes and demonstrator components. **(D9:13)**

Green Composites from Woven Flax Fiber and Bio-Copolyester
BR Guduri, H Semosa (CSIR) Y Meng (Sun Yat-Sen Univ)
In this work, natural fibre based biocomposites were prepared using natural fiber of flax woven fabric and aliphatic-aromatic copolyester matrix. The composites were prepared by compression moulding using a film stacking method. The mechanical, thermal, morphological and biodegradation properties of the biocomposites were investigated. The biodegradability test performed by soil burial method. **(D9:14)**



Water Absorption Behaviour of Pultruded Kenaf Fibre Reinforced Unsaturated Polyester Composites and its Effects on Mechanical Properties
HM Akil, N Nosbi, ZAM Ishak, AA Bakar (Univ Sains Malaysia)
Degradation behaviour of kenaf fibre reinforced composites upon exposure to environmental conditions is an important issue. Immersion of composites into various environments is an effective way to investigate the behaviour. Effect of water absorption on mechanical properties of composite is of interest to outdoor applications of composites. **(D9:15)**

Effect of Surface Treatment on the Mechanical Properties of Biocomposites
H Nakamura, N Shikamoto, A Nakai, H Hamada (KIT)
Natural fiber reinforced biodegradable resin composites are eco-friendly. However the interfacial properties between natural fiber and most of the biodegradable polymers are inadequate. In this study, by using shellac resin and amino silane coupling agent natural fiber was treated to improve the interfacial properties of jute spun yarn. **(D9:16)**

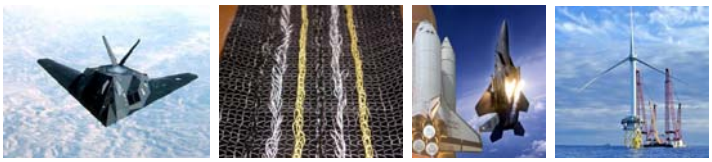
Natural Fibre Composites: Tough (Silk) and Strong (Bamboo)
AW van Vuure, J Vanderbeke, L Osorio, E Trujillo, I Verpoest (KU Leuven)
Silk fibres, due to their high intrinsic strain to failure, are converted into very tough composites, by combining them with matrices of high strain to failure and by targeting intermediate interfacial strength. Bamboo fibres, when extracted carefully, can maintain a high fibre strength and be turned into strong composites with good interfacial strength. **(D9:17)**

On the Competition between Layered Silicates and Cellulose Nano Fibres during the Reinforcement of Biodegradable Polymer Matrix
J Pandey (Seoul National Univ)
Cellulose nano-filler (CNF) and layered silicate were used as reinforcing agents for Poly (lactic acid) (PLA) in order to improve the thermal behaviour of composites which was not achievable by cellulose nano-fiber. The silicate layers were dominant than CNF and it is too early to use CNF based PLA matrixes for industrial applications. **(D9:18)**

Flax Fibres in Musical Instrument Soundboards
S Phillips, L Lessard (McGill Univ)
A flax fiber sandwich panel was developed for use as a musical instrument soundboard. The dynamic properties of the flax laminate were compared to those of the most widely used wood species. The dynamic Young's modulus, shear modulus and internal friction of both materials were used for comparison. A small prototype instrument was constructed using the studied flax laminate. **(D9:19)**

Nanostructured Composite Materials from Cellulose Nanofibers and Carbon Nanotubes
M Salajkova*, H Sehaqui, Q Zhou, L Berglund (Royal Inst of Tech) (*also at Brno Univ of Tech)
Nanotechnology, which consists of manipulating materials and devices of 100 nm or less in at least one dimension, provides us an opportunity to create advanced materials with hierarchical structures and develop cellulose-based materials with higher strength, greater optical transparency, or enhanced electrical and magnetic performances. **(D9:20)**

Development of Natural Hemp Fibre Sheet Mould Composites (NF- SMC)
G Ren (Univ of Hertfordshire) H Patel, D Hapuarachchi (QMUL) S Crowther (Menzolit) M Fan (Brunel Univ) PJ Hogg (Univ of Manchester)
This research investigated the use of natural hemp fibre as reinforcement for SMC as an alternative to glass fibre in the applications ranging from building construction, to automotive and aerospace industries which require good fire performance and mechanical properties. **(D9:21)**



Elaboration of Cactus Fibre Composite Laminate and Characterisation under Static and Fatigue Loading
A Bezazi, M Bouakba (Univ of Guelma) F Scarpa (Univ of Bristol)
In this work we present the results of a new method to extract cactus fibres for novel laminate biocomposites, together with the chemical characterisation of the biofibres. The composites are mechanically tested under uniaxial, fatigue tensile and bending loading. The cyclic fatigue investigations are related only to the cactus fibre/polyester composites laminate under flexural loading. **(D9:22)**

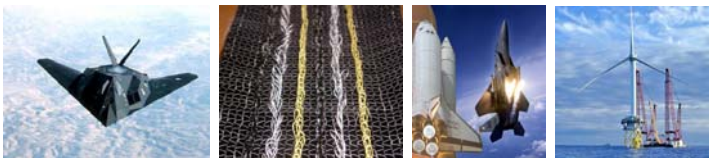
Biodegradability of a Silkworm Silk Fiber Reinforced Poly(Lactic Acid) Biocomposite
K Hoi-Yan Cheung (Hong Kong Polytech Univ)
Previous researches investigated the impact of silk fibers upon polymeric materials and gave attention to the development of biodegradable biocomposites. The purpose of this study is to advance the understanding of the mechanical properties of different types of silk fibers and the biodegradability of a silk fiber reinforced PLA biocomposite. (D9:22A)

Development of an Eco-Friendly CFF/PLA Biocomposite
PM Lam, KT Lau (Hong Kong Polytech Univ) YQ Zhao (Lanzhou Univ) S Cheng, T Liu (Ocean Univ of China)
Chicken feather fiber (CFF) was mixed with poly(lactic) acid (PLA) to fabricate a new kind of biocomposite. Fibers from two different parts of chicken feather were used as reinforcement to the polymer matrix. The mechanical properties of CFF/PLA biocomposite samples processed with a twin-screw extruder and injection moulder were examined. **(D9:23)**

The Potential Bio Based Polymer and their Nanocomposites for Composites Structure
J Denault, MTT That (National Research Council of Canada)
In this work, new formulations of cellulose fiber composites based on polypropylene (PP) have been developed for melt processing. This new approach allows eliminating the cellulose drying step and the safety challenge related to the high flammability of the dried cellulose source thus reducing sufficiently the overall processing energy and cost. In addition it can also improve significantly the mechanical properties and the flame resistance of the composites. **(D9:24)**

Properties of Natural Fibres for Composite Materials
D Jesson (Univ of Surrey)
Natural fibres, particularly those which form a waste material from other industries, areof interest to manufacturers as an easily sourced material, from which it is possible toproduce a composite material. The current work suggests that a cheap composite with commensurate mechanical properties could be produced based on oil palm fibre. **(D9:25)**

Characterization of the Hybrids Composites using Mats Made with Differents Methods
AJ Zattera, CAB Vieira, SB Susin, E Freire (Caxias do Sul Univ) SC Amico (Rio Grande do Sul Federal Univ)
This work is focused at development and evaluation of confection methods of short fibers hybrid mants aiming attend the necessities of automobile industry in the production of small parts with smaller cost and specific weight. Were developed different methods in the confection of hybrids mants from short fibers: manual deposition of the fibers, watery phase deposition of the fibers, fibers arrangement by stream bed fluidized and deposition of the fibers by vibrational method. **(ID9:1)**



Structure and Properties of Regenerated Cellulose Ultra-Fine Fibers from Kraft Pulp
F Ko, S Yeoh (Univ of British Columbia) W Hamad (FPInnovations)
In this study, we aim to produce regenerated cellulose fibers of high strength and dimensional stability by electrospinning. We demonstrate, for the first time, that kraft pulp/NMMO solutions could be electrospun into micro- and nano-fibers. SEM, IR, and tensile tests are used to establish the fiber structure-property relationships. **(ID9:2)**

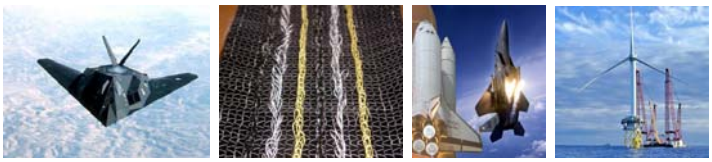
Applicability of Weibull Strength Distribution for Cellulose Fibers with Highly Non-Linear Behaviour
R Joffe (Lulea Univ of Tech) J Andersons, E Sparnins (Institute of Polymer Mechanics)
It is shown that tensile strength of cellulose fibers with the same length follow Weibull distribution. However, size effect predicted by the Weibull distribution for fibers with various lengths is not observed. This is most likely due to the highly non-linear behaviour of cellulose fibers. Applicability of the Weibull distribution is studied on fibers with different length via single fiber as well as bundle tensile tests. **(ID9:3)**

Natural Fiber Reinforced Polymer Biocomposites and Blends: Synthesis, Characterization and Applications
S Choudhury, SB Hazarika (Cotton College) AH Barbhuiya (Regional College of HE) BC Ray (Jadavpur Univ)
Polymer natural fiber blends and composites are replacing conventional plastic materials in a number of industrial and automobile uses. No work has been done with very hard, biodegradable betel-nut fiber occurring in India, Bangladesh and Burma. We have prepared and characterized polymer betel-nut fiber composites and blends for multipurpose uses. **(ID9:4)**

Study Mechanical, Swelling and Dielectric Properties of Prehydrolysed Banana Fiber - Waste Polyurethane Foam Composites
M Elmeligy (National Research Center)
Production of composite from polyurethane foam waste by using prehydrolysed banana fibers treated or untreated by maleic anhydride. Esterification of banana fibers by using maleic anhydride reduce swelling and improve both mechanic strength and dielectric properties of composite. **(ID9:5**

Biobased Composites Prepared by Compression Moulding using a Novel Thermoset Resin from Soybean Oil and a Natural Fibre Reinforcement
K Adekunle, D Akesson, M Skrifvars (Univ of Boras)
Biobased composites were manufactured by using a compression moulding technique. Novel thermoset resins from soybean oil were used as matrix while flax fibres were used as reinforcement. The fibres were treated with 4 % sodium hydroxide solution. The compression moulding temperature was set to 170°C. **(ID9:6)**

Development of Non-Woven Biofibre Mats for Composite Reinforcement
Z-C Yu, M Alcock, E Rothwell, S Mckay (Composites Innovation Centre)
Non-woven biofibre mats were successfully developed for composite reinforcement using low cost agricultural fibres grown and processed in Canada. The mats were fabricated through three methods and bonded by thermal melting and needle punching. Their features were experimentally assessed. The applicability was also discussed. **(ID9:7)**



Solution for FRP Pipes: Technical and Economic Advantages of Natural Fibers and of RTM Processing
G Cristaldi, G Cicala, G Recca (Univ of Catania) G Ziegmann (TU Clausthal)
The aim of the present research was to investigate the replacement of glass fibers with hemp fibers for a curved flanged pipe used in the chemical industry. Two processing techniques, namely hand lay up and light RTM, were evaluated. The comparison between hand lay up and light RTM evidenced a substantial cost reduction when light RTM was used. **(ID9:8)**

Influence of Hemp Yarn Treatments on Mechanical Properties of Woven Fabric Composites
C Bonnafous, F Touchard, L Chocinski-Arnault (LMPM ENSMA)
This study deals with hemp fibres woven fabric/epoxy composites. A multi scale mechanical characterisation combined with damage analysis by acoustic emission and microstructural observations has been performed. Different chemical and thermal treatments of hemp yarn have been tested and a comparative study has been made with glass fibre composites. **(ID9:9)**

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