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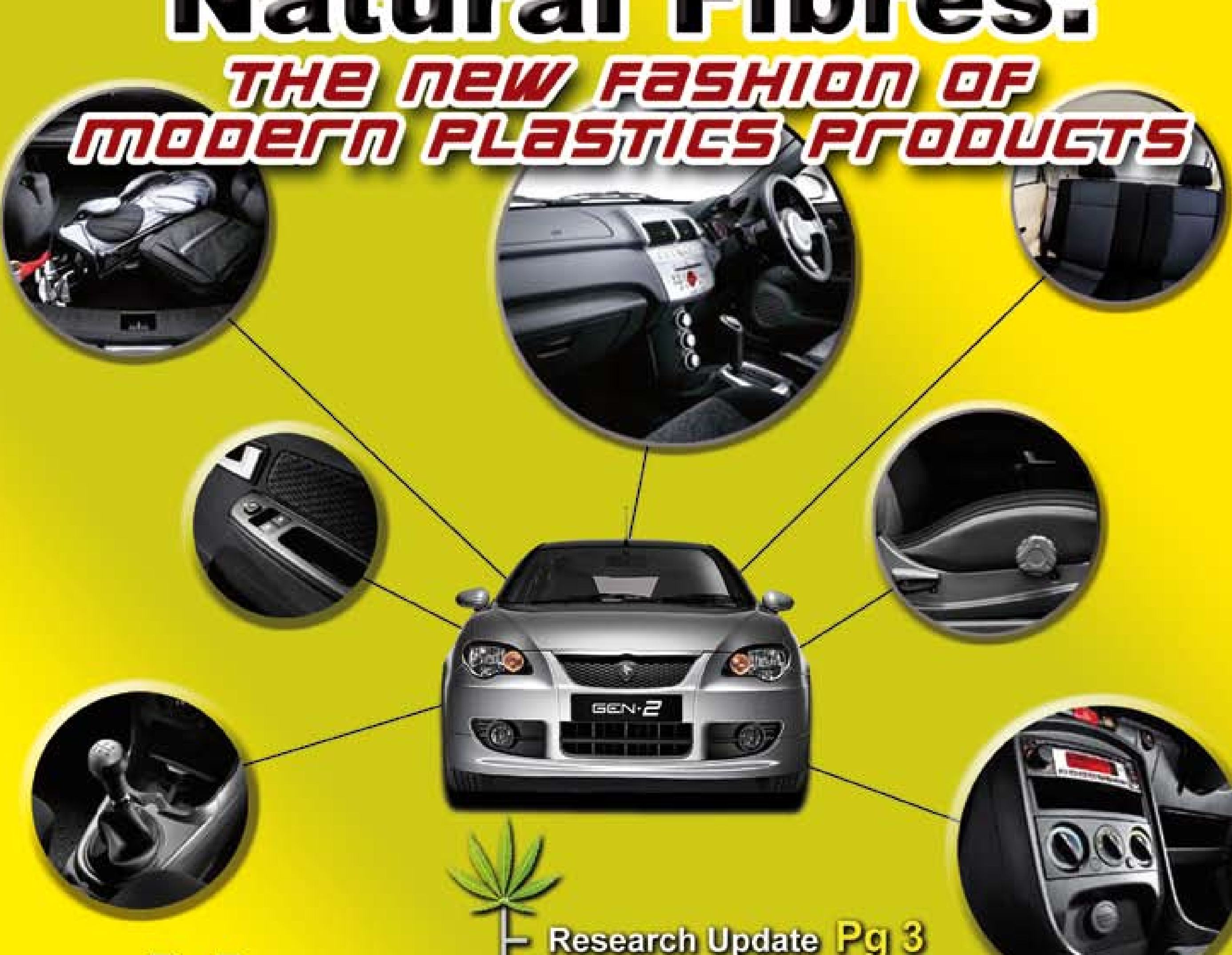
INSTITUTE OF TROPICAL FORESTRY AND FOREST PRODUCTS

Centre of R&D in Tropical Biocomposite and Canopy Management

Natural Fibres:

THE NEW FASHION OF MODERN PLASTICS PRODUCTS



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Message From The Editor

Bismillahirrahmanirrahim...

The history of mankind has witnessed several surges in the field of research and development. The rampant use of petroleum products has created a twin dilemma; depletion of petroleum resources and entrapment of plastics in the food chain and environment. The increasing pollution caused by the use of plastics and emissions during incineration is affecting the food we eat, water we drink, air we breathe and threatening the supreme right for human beings, the right to live. The exhaustive use of petroleum based resources has initiated the efforts to develop biodegradable plastics. This is based on renewable bio-based plant and agricultural products that can compete in the market currently dominated by petroleum based products. The production of 100% bio-based materials as substitute for petroleum based products is not an economical solution. A more viable solution would be to combine petroleum and bio-based resources to develop a cost-effective product having immense applications.

Biopolymers or synthetic polymers reinforced with natural or bio fibres (termed as biocomposites) are a viable alternative to glass fibre composites. Scientists are looking at the various possibilities of combining natural fibres with polymer matrices from non-renewable and renewable resources to form composite materials to make the biocomposite revolution a reality. The use of natural fibre materials in composites has increased due to their relative cheapness, their ability to recycle and for the fact that they can compete well in terms of strength per weight of material. Natural fibres can be considered as naturally occurring composites consisting mainly of cellulose fibrils embedded in lignin matrix. These fibres can be subdivided based on their origins, coming from plants, animals or minerals. All plant fibres are composed of cellulose while animal fibres consist of proteins (hair, silk, and wool). Plant fibres include bast (or stem or soft sclerenchyma) fibres, kenaf fibres, oil palm residue fibres (empty fruit bunch), leaf or hard fibres, seed, fruit, wood, cereal straw, and other grass fibres. The cellulose fibrils are aligned along the length of the fibre, which render maximum tensile and flexural strengths, in addition to providing rigidity. The reinforcing efficiency of natural fibre is related to the nature of cellulose and its crystallinity.

The history of fibre reinforced plastics began in 1908 with cellulose fibre in phenolics, later extending to urea and melamine and reaching commodity status with glass fibre reinforced plastics. The fibre-reinforced composites market is now a multibillion-dollar business. Though hailed as a miraculous discovery long back, plastic products now enjoy an ambiguous reputation. Scientists are now developing high-quality packaging of goods or utilizing the biomass residue to tackle the problem of high cost agro-waste disposal). After decades of obscurity, biofibre reinforced composites are being touted as the material of the millennium.

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INTROP: Research Updates

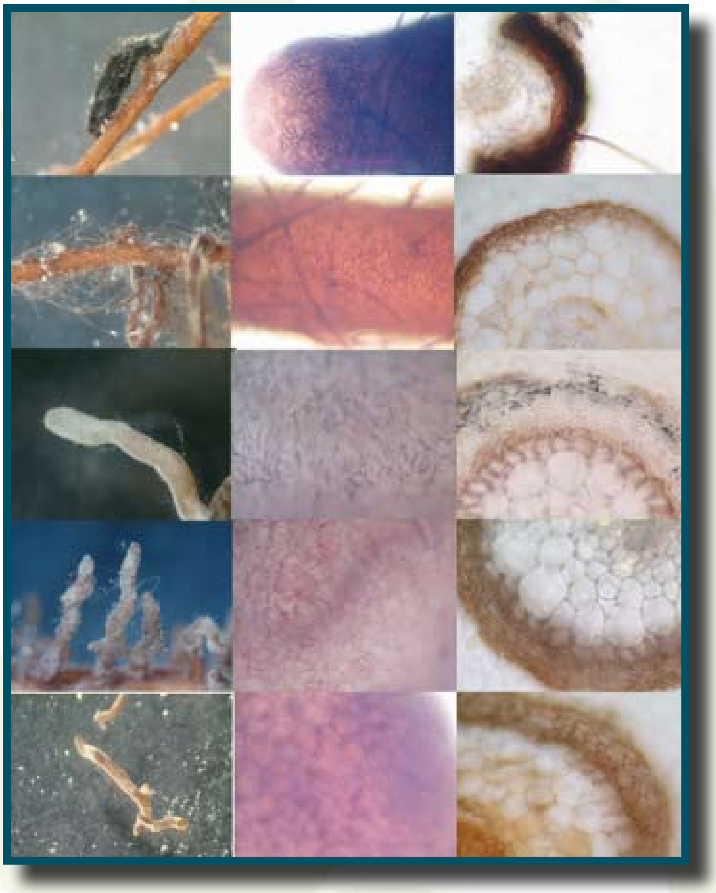
M. Jean Weber's research interest focuses on the ecology of ectomycorrhizal associations in relation with the diversity of trees and decomposer communities.

His post graduate studies at INRA (National Institute of Agricultural Research) in France were held on the molecular ecology of the Douglas fir – *Laccaria laccata* ectomycorrhizal association in forest plantations in France.

After moving to South East Asia in 2000, M. Weber started his doctoral work at the National Institute of Education in Singapore and University Nancy I in France where he studied the interactions of *Acacia mangium* with multiple symbiotic partners (rhizobia, endomycorrhiza and ectomycorrhiza) in aeroponics and other culture systems.

His post-doctoral research was conducted in collaboration with the Center of Tropical Forest Science and FRIM and focused on regeneration dynamics of ectomycorrhizal species in the Pasoh Forest Reserve.

Employed at INTROP since April 2008, M. Weber's project is to extend his current work on interactions between saprotrophic and ectomycorrhizal communities to the study of their role in carbon and nutrient cycling in peat swamp forests. An international integrated research project for the assessment of carbon balance and its components in peat swamp forest is currently in process to be set up.



Example of mycorrhizae sorted according to their morphotypes. Mycorrhizae are sorted according to their general aspect, the surface of their mantle and their organization observed on transversal sections.

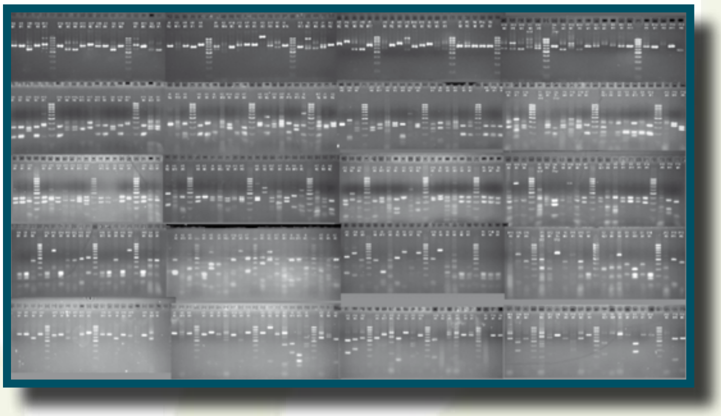


Illustration of ITS1–F/ITS4 RFLP polymorphism. Each column corresponds to an ectomycorrhizal fungus.

Unidentified ectomycorrhizae on *Shorea leprosula*. Some ectomycorrhizal fungi (in white) are capable to modify the form of the lateral root to which they are associated.

INTROP: Research Updates

Award Gold

Researcher
Prof. Dr. Nor Aini Ab. Shukor

Project Title
Infection of Gall Rust Disease on Falcataria Moluccana (Miq.) Barneby & Grimes Seedlings

Award Gold

Researcher
Assoc. Prof. Dr. Paridah Md Tahir

Project Title
Development of Durable Biocomposites through Pretreatment with Low Molecular Weight Phenolic Resin

Award Silver

Researcher
Assoc. Prof. Dr. Paridah Md Tahir

Project Title
Development of Veneer Drying System for Oil Palm Stem Veneers

Award Bronze

Researcher
Assoc. Prof. Dr Mohamad Pauzi Zakaria

Project Title
Environmental Crime Scene Investigation (ECSI): Tracing Down the Illegal Loggers using Chemical Fingerprint

Award Bronze

Researcher
Prof. Dr. Nor Aini Ab. Shukor

Project Title
Biomass production of Acacia mangium and Acacia aulacocarpa multiple-leadered trees in increasing carbon sequestration of afforestation programme

INTROP: Postgraduate Committee

On the 22nd of June 2008, Persatuan Siswazah INTROP (PSI) organized a trip to the Putrajaya Wetlands. It was heartening to say that 20 INTROP students joined this trip and it proved to be a very enjoyable trip indeed.

As soon as we arrived, a short briefing was given by the guide and we were divided into 4 groups, named humorously after various animal species found in Malaysia. They were Tapir, Cacing Kerawit (Hookworm...can't you give us a better name???), Tenuk and Siput Babi. Well, tenuk is actually a Malay name for Tapir (I guess the guides couldn't think of any of the other thousands of species that reside in our beautiful country...)

Our first activity was a treasure hunt that took us to every corner of the wetlands. In our effort to search and decipher clues, we had the opportunity to enjoy the glorious flora and fauna all around us. A sharp observer would have noticed the strong desire to win beneath the laughter and smiles of the participants. Being secretive and finding out something before someone else does was the key to success. Isn't that a trait commonly found among researchers? Hmmmm....

After losing a few kgs running around, we were allowed a moment breather before being submerged into an icy cold lake. It was probably a frightening yet rewarding experience for the ones who could not swim. Nevertheless, encouraged by 19 exuberant fellow knowledge seekers, each and everyone safely crossed the frighteningly placid and shallow lake.

Naturally, all 20 of us had a change of clothes after the dreadful experience of wearing a life jacket and crossing a perfectly calm lake with a rope as a guide and surrounded by 5 muscular lifeguards (actually, most were slightly overweight with a hint of a belly...but we definitely placed our trust in their swimming skills). We then had a seriously fun time cycling around the wetlands.

Shrieks of joy could be heard as the students released months of pent up stress in chasing deadlines and tedious lab work. The sheer exuberance in chasing a fellow PSI-ian (I just made up a new word!) was contagious and pretty soon everyone was grabbing a bicycle and riding around without a care in the world. The more daring ones rode the 'twin' bicycles meant for professional cyclists.

If an event's success can be measured by laughter, joy and building of friendship bonds, this trip would definitely be ranked high. The participants returned to UPM with the hope that someday in the near future, another event like this will be organized to break the monotony of life as a graduate student.

Natural Fibers: The New Fashion of Modern Plastics Products

By
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INTRODUCTION

The utilization of biomass has gained increased importance due to threats of uncertain petroleum supply in the near future and concerns about environmental pollution. Natural fiber composites are undergoing a high tech revolution and are replacing conventional composites in high performance applications due to their advantages over conventional reinforcements. The annual global disposal of millions of tones of plastics, especially from packaging, has raised the demand for means of managing this non-biodegradable waste. The use of biofibers in a thermoplastic matrix provides positive environmental benefits with respect to disposability and raw material utilization. Since biofibers are relatively less expensive and biodegradable, biocomposites from biodegradable polymers will render a contribution in the twenty-first century. Most sustainable plastics cannot compete economically with conventional petroleum-derived plastics in their present state. Economically favorable composites, therefore, are expected to be made from costly sustainable plastics in combination with inexpensive natural reinforcement fibers. Cellulosic materials are the most abundant form of biomass and the form most likely to be used as reinforcement fibers, not only for ecological and economical reasons, but also because of their high mechanical and thermal performance. To utilize and design materials successfully for industrial applications, it is first imperative to determine material properties that will affect performance.

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Source: http://www.margaretscleaners.com/

Source: www.bayer.com.

Source: Daimler Chrysler

ENVIRONMENTAL BENEFITS OF USING NATURAL FIBER-REINFORCED THERMOPLASTICS

The primary environmental advantages of using natural fiber-reinforced thermoplastic are as follows:

- Biodegradability
- reduction of greenhouse gas emission
- enormous variety of structural fibers available throughout the world
- creation of job opportunities in rural areas
- development of non-food agricultural/farm-based economy
- low energy consumption
- low cost
- low energy utilization.

Using agricultural materials as raw materials for making composite products provides a renewable resource as well as generating a non-food source of economic development from farming and rural areas. Also, use of renewable fibers in the composites produces an overall CO_2 balance, as the amount of CO_2 taken up during their growth is matched (apart from the efforts necessary to grow and harvest the fibers) by the CO_2 released during their disposal, i.e. either by burning or by rotting. Replacing conventional fibers based on petroleum resources with natural fibers reduces the greenhouse gas emissions considerably. The amount of energy required for the production of natural fibers is less than that of glass fibers. Moreover, their lower density (>40%) compared to glass fibers leads to fuel-efficient production of composite products, especially in automotive applications: this, in turn, leads to a reduction in greenhouse gases[1]. The carbon sequestration and storage potential of hemp-based natural fiber mat thermoplastic composites has been estimated to be about 325 kg carbon per metric tonne during their useful lifetime[2]. A net carbon sequestration of 0.67 ton/ha/yr was estimated for a composite containing 65 wt % of hemp fiber. It has been found that replacing 30% glass fiber with 65% hemp fiber in thermoplastic composites produces a net saving of energy consumption of 50 000 MJ (about 3 ton CO_2 emission) per ton of thermoplastic. Also, by substituting 50% of the glass fiber by natural fiber in automotive applications, 3.07 million tons of carbon dioxide emissions and 1.9 million m^3 of crude oil can be saved.

RECYCLING ASPECT OF COMPOSITES

Natural fiber-filled thermoplastic composites are easier to recycle than the conventional mineral-based fiber filled thermoset composites. This is due to the less brittle nature and softer texture of the fiber and the processibility of the thermoplastic. Unfortunately, not much literature is available regarding the recycling of post-consumer products. The repeated process of injection molding and granulation and the influence of this process on the mechanical properties of wood fiber-filled composites have been studied by Sain and Balatinecz (1997)[3]. The properties of the composites after reprocessing three, six and eight times are given in Table 1[3]. The deterioration in the properties is due to fiber attrition and oxidative degradation of the PP matrix during the repeated grinding and injection molding processes.

Table 1. Properties of recycled wood fiber polyolefin composites

Number of recycling	Property	Polypropylene	30% wood fibre-filled PP	45% wood fibre-filled PP
0	Tensile strength (MPa)	28.76	38.00	36.77
3		26.31	33.08	29.38
6		27.00	31.38	31.08
8		26.00	30.46	–
0	Flexural strength (MPa)	40.5	60.67	65
3		34.67	54.33	59.67
6		40.67	60.33	53
8		38.33	53	–
0	Flexural modulus (GPa)	1.7	4.3	8.0
3		1.1	4.4	11.3
6		1.8	5.1	6.9
8		1.5	4.0	–
0	Melt flow index (g/10min)	11.04	1.46	10.00
3		16.25	1.88	12.71
6		24.80	3.13	7.50

FUTURE TRENDS

Owing to their renewability, worldwide distribution and recyclability, the market for these composites will be able to expand. It will be possible for them to be used in a wide range of products, from those where very inexpensive low performance composites are suitable, to those where expensive high performance structural components are required. They have an increasing market demand, especially among automobile companies looking for light-weight materials with sound damping properties[4]. In 1941, the Ford Motor Company, USA, investigated composites, which were soybean oil based. The Toyota Motor Corporation, Japan, made a commercialized vehicle with door trim panels made of kenaf–PP composite and a cover for a spare tyre made of kenaf–PLLA composite.

So far, natural fiber composites are favored mainly because of their green image and sustainability. They also exhibit excellent mechanical and thermal properties, and low density as revealed above. Other disadvantages such as water resistance properties should be able to be overcome in the near future. In addition to their environmentally friendly characteristics, green composites should provide excellent economical performance for acceptance in large quantity markets. It has been reported that composites based on polyolefins offer advantages of a 30% weight reduction in addition to a 20% reduction in processing temperature and a 25% reduction in cycle time. Researchers are also trying to produce hybrid composites containing different types of fibers for high performance applications. Green composite materials based upon thermosetting resins in combination with long natural fibers such as flax and hemp, offer potential in true structural applications. With few exceptions, however, there has been little in the way of commercialization of such materials. Nevertheless, significant research efforts are being directed towards the development of fully bio-based composite materials suitable for structural uses, in applications ranging from leisure goods to construction components. Unlike biodegradable polymers, however, there are few thermosetting resins based upon renewable resources currently available commercially. This has tended to limit composites reinforced with natural fiber to those incorporating petrochemical-based resins such as unsaturated polyesters and epoxies. In time, it is to be expected that bio- based thermosetting resin systems, competitive in terms of cost and performance may well become available. This would open up new and exciting possibilities for true structural 'green' composites.

'GREENNESS'

If 'green' composites are to be marketed on this basis, then it is vital that they can substantiate their environmental credentials. Life cycle assessment (LCA) is a tool that can be applied to assess the environmental impact of a particular product on a 'cradle to grave' basis. The results of LCAs can be revealing and it is by no means a given that if, for example, glass fiber reinforcement is replaced directly with a natural fiber alternative the product will be 'greener'[4,14]. It has been demonstrated that the greatest impact in environmental terms often arises from the polymer matrix, usually derived from petrochemical resources, rather than from the reinforcement fiber[15]. It is partly for this reason that there is a significant amount of research interest being directed towards the development of bio-based thermosetting resins and of renewable resource-based biodegradable thermoplastics. Thermoplastics such as the Cargill Dow LLC 'NatureWorks™ PLA', a cornstarch-based polylactic acid thermoplastic or Novamont's 'Mater-Bi', a starch-based thermoplastic are examples of renewable resource-based polymers currently in commercial production. A number of bio-based thermosetting resins are under development. These include materials based on various vegetable oils such as soy, linseed, cashew nut shell liquid and oilseed rape. One of the most notable of these is Cara Plastic's thermosetting resin based on soy oil[16]. The development of polymer resins and plastics from renewable resources offers the potential for producing true green composite materials, which could carry real environmental advantages over the current range of synthetic composites and it is likely that these will feature at the forefront of green composite technology in the future.

CONCLUSIONS

Although the history of the application of green composites can be traced back to the mid-nineteenth century, it is only in the last decade or so that renewed interest has been shown in these materials. This interest has been spurred on by a number of factors, but potentially the most significant of these is the desire to lessen the effects of mankind's activities upon the environment to 'green' our materials. In this respect, there is significant potential for composites based upon renewable resources. Although at present the commercial applications for green composites are limited, principally to biocomposites for some construction and automotive applications, ongoing research and development programmes into bio-polymers and natural fiber-reinforced composites is likely to lead to further advances and new opportunities in this sector. Underpinning this potential growth is significant political impetus to reduce or recover waste and to increase the use of renewable materials in place of fossil reserves.

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Natural Fibres and the BIOCOMPOSITES INDUSTRY

BY: ASSOC. PROF. DR. PARIDAH MD TAHIR

Kenaf long fibres used for biocomposite industry.

Natural fibres have played a major role throughout human history. Even the earliest humans learned to use these resources to make shelters, cook food, construct tools, make clothing, paper, and produce weapons. Collectively, society learned very early the great advantages of a resource that was widely distributed, multi functional, strong, easy to work with, aesthetic, biodegradable, and renewable. Compared to synthetic fibres made from glass, carbon and steel, natural fibres have a high aspect ratio, high strength to weight ratio, relatively low in energy conversion, and have good insulation properties (sound and thermal). The fiber structure varies depending on the type of fibres, for instance hemp has hollow structure, whilst kenaf has a woody inner core. Some might consider part of these properties as problems, such as biodegradable and combustible, but these features provide a means of predictable and programmable disposal not easily achieved with other resources.

Early manufacturing entrepreneurs must have started off using naturally occurring composite materials such as wood, horn, sinew, bone and plant fibres before moving on to metals and ceramics. It is somewhat later in history that the fibre reinforced resin matrix composites make their appearance. The history of biocomposites has dated back since 500BC, where Athenian Hoplites (now Greece) used resin bound linen to make the Lineothorax, a tough and light cuirass type body armour. Across the world, in late medieval Japan, lacquered Chinese water buffalo hide and papier-maché were used for similar effect. Some 3,000 years ago in ancient Egypt, clay was reinforced by straw to build walls. These inventions continued to invade the world until today where its' effects can still be seen. One good example of such invention is the Great Wall of China which was constructed in the VI century that owes it's durability to the addition of rice flour to the clay as binding material. Small particles of the rice flour ensured the durability of the biggest human construction until today.

The history continued where in the late 1930's, Henry Ford used soya oil to produce phenolic resin for making wood filled composite material for car bodies. Since then " a bushel of soya" went into every model of Ford, including spun fibre for upholstery. Meanwhile, in the U.K, a flax reinforced Spitfire fuselage was made in the 1940's at Duxford, Cambridgeshire. At about this point, the modern civil composites industry started off a curious combination of high-tech aeronautical applications and minimal capital outlay contact moulding methods for the manufacture of large low production volume mouldings such as boats and sports car bodies. Since then, the focus has shifted from natural fibre reinforcements to artificial - mostly glass in the first instant, and cold cure polyester resins. The development story of modern composites industry starts here, with artisan methods making way for automated manufacture, and all the while, the parallel development of resin chemistries, fibre sizes and architectures, all focused on a relatively small range of resins, mostly epoxies, polyesters, and phenolics, and a small range of artificial fibres such as

Kenaf long fibres in reel form.

Moulded kenaf plastic composite for car components.

glass, carbon and aramid. During this pursuit of ultimate mechanical properties and manufacturing convenience, natural fibre composites fell into abeyance.

THE REVIVAL OF NATURAL FIBRES

What we might call the modem wood composite industry had its beginning in the late 19th century in Switzerland. A type of glue laminated beam was made for an auditorium using a casein adhesive. The world plywood industry started around 1910, the particleboard industry in the 1940's, the hardboard industry around 1950, and the medium density fiberboard (MDF) industry in the early 1960's. Later in history, the resin matrix bonded fibrous reinforcement articles (which are presently known as biocomposites) make their appearance. A biocomposite material is formed by a combination of a matrix or resin and a reinforcement of natural fibers (usually derived from plants or cellulose). Biocomposites materials have wide-ranging uses from environment-friendly biodegradable composites to biomedical composites for drug/gene delivery, tissue engineering applications and cosmetic orthodontics. They often mimic the structures of the living materials involved in the process in addition to the strengthening properties of the matrix that was used but still providing biocompatibility, e.g. in creating scaffolds in bone tissue engineering. Biocomposites are characterised by the fact that:

- the petrochemical resin is replaced by a vegetable or animal resin, and/or
- the bolsters (fiberglass, carbon fibre or talc) are replaced by natural fibres such as wood, kenaf, hemp, flax, sisal, jute etc.

Professor Roger Rowell from University of Wisconsin, Madison, USA estimated that there are over 4 million dry metric tons of natural fibres available in the world. Natural fibres can be produced from different parts of plant such as bast, leaf, seed, fruit, wood, grasses and reeds, depending on the types of plant. These plants are rich in cellulose which is the building material of long fibrous cells, a natural polymer with high strength and stiffness per weight. Cellulose can be found in the stem, the leaves or the seeds of plants. During the last decade there has been a renewed interest in the natural fibre as a substitute for glass, motivated by potential advantages of weight saving, lower raw material price, and 'thermal recycling' or the ecological advantages of using resources which are renewable. Natural fibres, however, have their shortcomings, and these have to be solved in order to be competitive with glass or other matrices such as epoxies, polyester, etc. Even though natural fibres have lower durability and lower strength than glass fibres, their properties can be improved tremendously through pretreatment of fibre.

BAST FIBRES

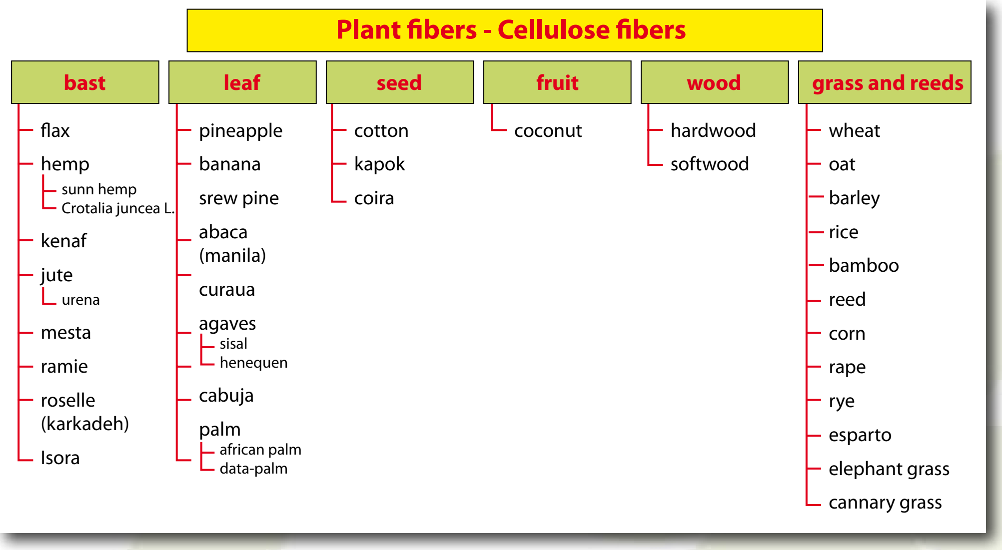
In general, the bast consists of a wood core surrounded by a stem. Within the stem there are a number of fibre bundles, each containing individual fibre cells or filaments. The filaments are made of cellulose and hemicellulose, bonded together by a matrix, which can be lignin or pectin. The pectin surrounds the bundle thus holding them on to the stem. The pectin is removed during the retting process. This enables separation of the bundles from the rest of the stem. Some examples of plants of this nature include kenaf, flax, hemp, jute and ramie.

During the processing of a biocomposite, the fibre bundles are normally sprayed/impregnated with a synthetic resin prior to being compressed at certain conditions. The strength of the resulting biocomposites depends very much on the cleanliness of the individual fibre for instance, in the case of flax, a much stronger composite is obtained if the fibre bundles are pre-treated with alkali to remove the lignin between the cells.

THE USE OF NATURAL FIBRES IN BIOCOMPOSITE INDUSTRY

The use of natural fibres for technical composite applications has been the subject of intensive research in both Europe and USA. Many automotive components are already produced in natural composites, mainly based on polyester or PP and fibres like flax, hemp or sisal. The adoption of natural fibre composites in this industry is lead by motives of : 1.) price 2.) weight reduction and 3.) marketing ('processing renewable resources') rather than technical demands. The range of products is restricted to interior and non-structural components like door upholstery or rear shelves.

There are many new product potentials to be considered for future development. Markets for existing products will expand but whole new markets are possible. Some of the applications of natural fibres include geotextiles, filters, sorbents, structural composites, non-structural composites, molded products, packaging, and combinations with other resources. Geotextiles are made using long bast or leaf fibers from such plants as kenaf, jute, cotton, sisal, agave, etc. which can be formed into flexible fiber mats via either physical entanglement (carding), nonwoven needling, or thermoplastic fiber melt matrix technologies. In carding, the fibers are combed, mixed and physically entangled into a felted mat. These are usually of high density but can be made at almost any density. A needle punched mat is produced in a machine which passes a randomly formed machine made web through a needle board that produces a mat in which the fibers are mechanically entangled. The density of this type of mat can be controlled by the amount of fiber going through the needle board or by overlapping needled mats to give the desired density. In the thermoplastic fiber matrix, the natural fibers are held in the mat using a thermally soften thermoplastic fiber such as polypropylene or polyethylene. Medium- to high-density fiber mats can be used in several ways and one of if is as Geotextiles. Geotextiles have a large variety of uses such as mulching mat for newly planted seedlings. The mats provide the benefits of natural mulch; in addition, controlled-release fertilizers, repellents, insecticides, and herbicides can be added to the mats as needed.



Sources of cellulose fibres from various parts of plants (Kozlowski, 2006)

Table 1. World Inventory of Biomass

Fiber Source	World (dry metric tons)
Wood	1,750,000,000
Straws	1,145,000,000
Stalks	970,000,000
Sugar cane	75,000,000
Reeds	30,000,000
Bamboo	30,000,000
Cotton staple	15,000,000
Core (jute, kenaf, Hemp)	8,000,000
Papyrus	5,000,000
Bast (jute, kenaf, hemp)	2,900,000
Cotton linters	1,000,000
Esparto grass	500,000
Leaf (sisal, abaca, henequen)	480,000
Sabai grass	200,000
TOTAL	**4,033,080,000**

Source: Rowell, 2006

Some advantages and disadvantages of natural fibres

ADVANTAGES	DISADVANTAGES
Low specific weight than glass	Lower strength properties particularly its impact strength
Higher specific strength and stiffness - benefit especially in parts designed for bending stiffness	High moisture absorption
Renewable resource - production requires little energy, CO2 is used while oxygen is given back to the environment.	Low durability
Producible with low investment at low cost	Variable quality
No wear of tooling, no skin irritation	Poor fire resistance
Thermal recycling is possible	Price can fluctuate

Properties of natural fibres in comparison with glass fibres

Properties	Fibre Type									
	E-glass	Kenaf	flax	hemp	jute	ramie	coir	sisal	abaca	cotton
Density g/cm3	2.55	1.5	1.4	1.48	1.46	1.5	1.25	1.33	1.5	1.51
Tensile strength* 10E6 N/m2	2400	350-600	800 - 1500	550 - 900	400 - 800	500	220	600- 700	980	400
E-modulus (GPa)	73	40	60 - 80	70	10 - 30	44	6	38	-	12
Specific (E/density)	29	27	26 - 46	47	7 - 21	29	5	29	-	8
Elongation at failure (%)	3	2.5-3.5	1.2 - 1.6	1.6	1.8	2	15 - 25	2 - 3	-	3 - 10
Moisture absorption (%)	-	-	7	8	12	12 -17	10	11	-	8 - 25
price/Kg ($), raw (mat/fabric)	1.3 (1.7/3.8)	0.33-0.88	- 1.5 (2/4)	0.6 - 1.8 (2/4)	0.35 1.5/0.9 - 2	1.5 - 2.5	0.25 -0.5	0.6 - 0.7	1.5 - 2.5	1.5 - 2.2

** tensile strength strongly depends on type of fibre, being a bundle or a single filament (Source: Kozlowski, 2006)*

Kenaf As New Raw Material In Pulp And Paper Industries In Malaysia

by: NORHAYATI BT NEK OMAR

The papermaking industry in Malaysia is gearing into high demand for new material and a supply constraints is becoming increasingly crucial. The current supply of recycled paper proves insufficient and Malaysia is now trying to use new raw materials especially in the production of high quality paper. This scenario was drawn from the Status and Market Information for Pulp and Paper Industry in Malaysia for 1992 and 1993 report that showed the demand on paper in Malaysia has increased by about 27%. These included writing and printing papers, newsprint, toilet/facial tissue papers, wrapping, kraft/corrugating medium papers, cigarette paper and also joss paper.

Malaysia has slightly weak pulp and a paper industry with insufficient production to fulfill domestic need. The world industry standards produce more than 300 000 T capacity per year a volume not exceeded by any mill in the country. The nearest was the Malaysian Newsprint Industries (MNI) located at Mentakab, Pahang and established in 1999 with capacity of 250,000 T/year in newsprint paper. Another integrated pulp mill is Sabah Forest Industries (SFI) located at Sipitang, Sabah under the Lion Group with production of 125 000T/year of pulp (90% hardwood, 10% acacia) and 165 000 T/year of paper. All Malaysian pulp and paper mills rely on recycled paper and imported pulp as raw material.

Against this scenario the introduction of kenaf provides “the light at the end of the tunnel” in raw material supply for the national paper industry. Kenaf is a native plant in East-Central Africa and introduced into Eastern Europe in early 1900. This

member of the Malvaceae family is also known as *Hibiscus cannabinus* L. and closely related to cotton and okra. Kenaf can grow to a height of 3.7 m - 5.5 m in as little as 4-5 months under suitable temperature, soil and rainfall conditions. As a source of raw material for paper Kenaf has the coveted credentials of renewable source, fast growing, biodegradable and environmentally safe.

Kenaf matures at 150 days of planting and is easily adapted to many countries and climates. This fast growing species comprise two main fibres which segregate into bast, the outer layer and the core fibre in the inner part of the stem. The outer bast comprises 40% of fibre similar to softwood fibre, while the inner core fibre is similar to that of hardwood. The cellulose content is comparable to that of wood, while the lignin content is comparatively much lower.

High quality papers are measured in terms of brightness, opacity, surface physical strength and printability properties. Kenaf-based newsprint as against wood-based ones, has advantages of good ink retention, good adaptation to modern newsprint machinery and does not readily yellow with age. Its long fibre length and this width tends to make kenaf into dense well-formed/well-bonded paper which contributes to high burst, good folding endurance and breaking length. The latest research in kenaf is the production of high quality currency paper to replace the traditional cotton fibre.

INTROP: Activities

Staff Integrity and Service Course

Date : 14-16 March 2008
Venue : Nur Lembah Pangsun
Eco-Resort, Hulu Langat,
Selangor

Staff Integrity and Service Course of Institute of Tropical Forestry and Forest Products (INTROP) was participated in by all the non-academic staff of INTROP.

The activities in this course was arranged to strengthen the *'ukhwah'* (relationship) among all staff. The course includes indoor and outdoor activities.

INTROP's Promotion Day

Date : 2nd April 2008
Venue : Tongkat Ali Emas Room,
4th Level, Institute of
Bioscience UPM.

This program was held to promote graduate programs in INTROP and all laboratories under INTROP were involved including representative from School Graduate of Studies (SGS). During the program participants were introduced to INTROP's background, fields of studies and research areas. Participants interested in pursuing their studies in INTROP could immediately register on that day with benefit of free registration fee by SGS. The program received overwhelming support and response from participants. Due to its success, INTROP will convene the event annually.

Round Table Discussion on UNFCCC (United Nations Climate Change Conference) Bali : Implications Towards Forestry In Malaysia

Date : 30 April 2008
Venue : INTROP 2, Meeting Room, UPM

In conjunction with the UNFCC Bali on 3-14 December 2007, the Forestry Science and Management cluster organized the Round Table Discussion on UNFCCC Bali : Implications towards Forestry in Malaysia. Three speakers, who attended the Bali Round Table were invited to give a talk on climate change. They were Dato' Hj Dahlan Taha (Deputy Director Forestry Department), Dr. Abdul Rahim Nik (FRIM) and Prof Dr. Mohd Shahwahid Hj Othman (UPM).

The objective of the Round Table were as follows:

1. To bring up to date Forestry issues what were discussed in the UNFCCC Bali.
2. To discuss and respond to the issues in the perspective of the Malaysia Scenario.

INTROP: Activities

Workshop on Safety at Workplace (Part I and II)

Date : 19 March 2008 and 7 August 2008
Venue : Auditorium, Institute of Bioscience, UPM

The objectives of this workshop included the following:

- To create awareness on aspect of safety and health at workplace.
- To illustrate the procedures and methods on material and chemical handling in laboratory.
- To minimize and prevent accidents at workplace.

All INTROP's staff participated in this workshop.



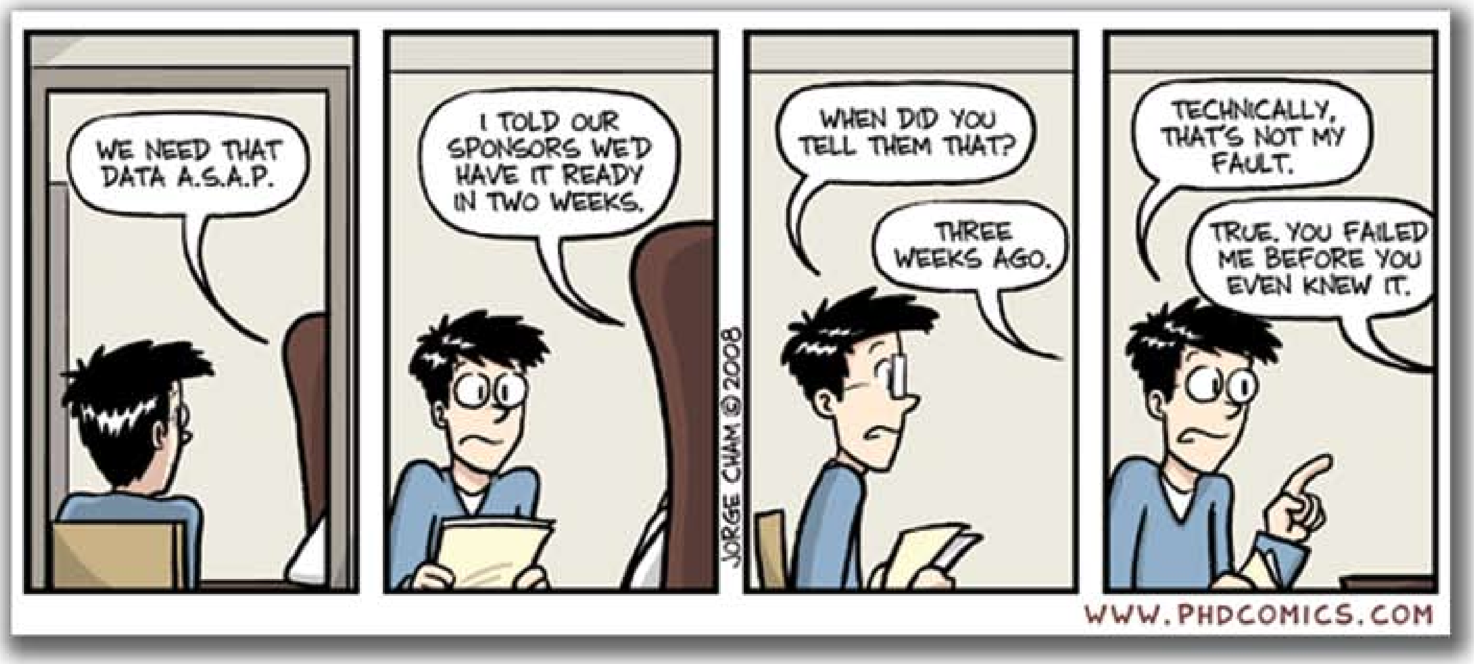



Technical Visit to Saharanpur, India.

Date : 15-19 April 2008
Program : Visit to Center of Pulp and Paper Research Institute (CPPRI)

Assoc. Prof. Dr. Jalaluddin Harun undertook a technical visit to India in April 2008. The visit identified a suitable place for pilot-scale trial on kenaf. The feasibility study will look into the utilization of kenaf fibre as a potential material for pulp and paper manufacturing.





Tips Corner

The rhizomes (underground stem) and stems of ginger have assumed significant roles in Chinese, Japanese and Indian medicine since the 1500s.

As a herbal medicine, *Luyang Dilaw* or Ginger Root (scientific name: *Zingiber officinale*) has long been used as a cold, cough, fever and sore throat remedy.

Ginger root is widely used as a digestive aid for mild stomach upset and is commonly recommended by health care professionals to help prevent or treat nausea and vomiting associated with motion sickness, pregnancy, and cancer chemotherapy. Ginger is used as support in inflammatory conditions such as arthritis, and may even be used in heart disease or cancer

Other uses

- Although it is much too early to tell if this will benefit those with heart disease, a few preliminary studies suggest that ginger may lower cholesterol and prevent the blood from clotting. Each of these effects may protect the blood vessels from blockage and the damaging effects of blockage such as atherosclerosis, which can lead to a heart attack or stroke.
- Laboratory studies have also found that components in ginger may have anticancer activity. More research needs to be performed to determine the effects of ginger on various cancers in humans.

References: University of Maryland Medicinal Center, www.umm.edu/altmed/articles/ginger-000246.htm, http://www.enotalone.com/article/9299.html, http://www.philippineherbalmedicine.org/ginger.htm

Hadith

Modesty and faith exist together, when one disappears, the other also disappears.

- (Al-Baihaqi)

The 5 daily prayers, the Friday prayer and fasting between months of Ramadhan nullify all that is between them as long as one guards against major sins.

- (Muslim)

Whoever clothes a naked Muslim will clothed by Allah with green robes of Paradise; whoever feeds a hungry Muslim will be fed by Allah from fruits of Paradise; and whoever gives drink to a thirsty Muslim will be given drink by Allah from fountain (of paradise)

- (Abu Daud and At Tirmidhi)