SESSION 10

BIOCOMPOSITE TECHNOLOGY AND BIOBASED PACKAGING

INVITED SPEAKER

The Properties and Processing of Biopolymers for Packaging Application

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Plastic packaging represented 36% of global plastic production in 2015. It is estimated that just 9% of all plastic ever produced has ever been recycled, 12% has been incinerated but the remaining 69% has either been land filled, dumped or ended up as litter in the environment. Growing public and governmental concerns around plastic packaging, particularly single use plastics, have led to more than 60 countries introducing regulations to limit the use of plastic bags and Styrofoam products. These measures are predicted to be a step towards further policies aimed at reducing plastic waste by replacement with more sustainable, environmentally friendly alternatives. Biopolymers made from renewable resources received increased attention for replacing conventional nonbiodegradable plastics. Among biodegradable polymers, polybutylene succinate (PBS) has emerged as one of the popular choices due to the good processibility and mechanical properties. The key drawback for PBS (also for most of other biopolymers) is the high cost. In order to reduce cost, low cost biopolymer of starch (and fibres) were chosen to blend with PBS to produce cost competitive fully biodegradable packaging product.

Keywords: Biopolymer, PBS, EFB fibre, packaging

INVITED SPEAKER

Evolution of Composite Materials

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In olden days, a mixture of mud and straw was used to build strong and durable buildings and Straw used as reinforcement in ancient composite products including pottery and boats. Afterwards a combination of wood, bone and animal glue, bows were pressed and wrapped to produce powerful and accurate composite bow. Natural resins derived from plants and animals were the only source of glues and binders. The modern era of composites began with plastics such as vinyl, polystyrene, phenolic, and polyester and these new synthetic materials outperformed single resins derived from nature. However, plastics depend on some reinforcement to provide enough strength and rigidity for structural applications. After the introduction of fiber glass, when it is combined with a plastic polymer created an incredibly strong structure that is also lightweight. This paves the way for the Fiber Reinforced Polymers (FRP) industry. The demand rose for the emergence of alternative materials with the essential traits like lightweight, strength and eco-friendly to handle in diversified fields like military aircraft, marine applications etc led to the development of composites. The composites industry is still evolving, with much of the growth now focused around renewable energy. Wind turbine blades, especially, are constantly pushing the limits on size and require advanced composite materials. A lot of research work on composite materials is being conducted towards development of bio-based composite materials with nano materials made from waste products, such as agricultural waste, building materials, plastic drink containers etc.

Keywords: Fiber Reinforced Polymers, plastic, composites, structural

ID: O43

Performance of Oriented Strand Board (OSB) Made from Oil Palm Trunk Strand

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Malaysia have many of oil palm waste such as oil palm trunk (OPT) from oil palm plantation. The Oil palm trunk that has reached 25 to 30 years old will be felled and can be converted into more profitable and value added products. The most forthcoming structural application is for bio composite panel such as Oriented Strand Board (OSB). This study identifies the performance of oil palm trunk strands on the properties of OSB bonded with Phenol formaldehyde (PF) resin. Three-layers OSB were fabricated with three resin level: 7%, 9% and 12% respectively and two targeted board-density: 0.64 gcm^{-3} and 0.78 gcm^{-3} respectively. The orientation of strands for each of layer was arranged accordingly. For upper top and bottom layer, the strands were in the same direction, meanwhile, random arrangement for core. The physical and mechanical properties of the boards were evaluated based on ASTM D1037 standards and test methods for evaluating properties of wood composites material and the results were further compared to EN 300 standard for grade OSB panels. The board properties tested includes density, moisture content (MC), water absorption (WA), thickness swelling (TS), modulus of rupture (MOR) and modulus of elasticity (MOE). As expected, the properties of the board increased as the increment of board density and adhesive ratio. In general, it was found that board with highest density and adhesive ratio shows superior performance in all properties tested and is very suitable in the application one of the panel structure in bus manufacturing.

Keywords: Oil palm trunk, OSB, biocomposite, performance, strands

ID: O44

Evaluation of Mechanical Properties of Natural Fiber Mat/ Fiber (NFMF) Hybrid Composites

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The need for stronger materials and at the same time lighter in weight, has induced sustainable approaches in the development of renewable and hybrid composite materials. The main purpose of this paper is to develop a bio hybrid composite (Biodegradable) and to accomplish the need for a stronger material which is eco-friendly as well. There are thousands of species of natural fibers, however, this paper has placed its centre of attention, on natural agricultural wastes, which are in abundance and whose production can also be increased as per the need. In the present study, natural materials like flax, Aloe Vera fiber mats and sisal fiber were used as reinforcing materials with epoxy as the resin. Tests are conducted to measure Mechanical properties like flexural, impact, tensile strengths and hardness, and are compared for various combinations. The fabrication or the manufacturing was done by the hand lay-up process.

Keywords: Bio hybrid Composites, Natural Fibers, Mechanical properties, Hand layup method.

ID: O45

Evaluation of Mechanical properties of Natural Fibre Mat and Fibre (NFMF) Hybrid Composites by experimental and FEA

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The sole purpose of this paper is to create a bio hybrid composite (Biodegradable) to satisfy the purpose of a strong material which is Eco-Friendly as well. There are number of species of natural fibres, however, this paper has majorly been turned on natural agricultural wastes, which are in abundance and whose production can also be increased as per the need. In the present study, natural materials like flax fibre woven mat, Aloe Vera fibre Woven mat, and sisal fibre were used as reinforcing materials with epoxy as the resin. The fabrication or the manufacturing was done by the hand lay-up process. All the experimental tests are carried out on standard ASTM sized samples to measure Mechanical properties like flexural, impact, tensile strengths and hardness. And also, we create the ASTM standard specimen models and do the analysis by using Finite Element Analysis Method (ANSYS 16.2). Finally compare the results of analytical and experimental values

Keywords: Natural fibres, mechanical properties, FEA Method.

ID: O46

Evaluation of Thermal Properties of Natural Fibre Woven Mat & Fibre Hybrid Composites

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The need for composite material has increased, as a requirement for stronger materials is in a great demand, for various purposes in the automobile, mechanical, aerospace industries. Natural fibre-reinforced hybrid composites can be a better replacement for plastic materials. In the present study, natural materials like flax fibre woven mat, Aloe Vera fibre Woven mat, and sisal fibre were used as reinforcing materials with epoxy as the resin. The aim of the study is to analyze the thermal properties of the composite, which were studied and compared. The thermal test is needed to test the deformation of the composite material due to thermal load, so we do the tests like thermo gravimetric analysis (TGA), heat deflection analysis (HDA), water absorption test (WAT), scanning electron microscope (SEM) are conducted and analysis the results in various combinations.

Keywords: Hybrid composite, Thermo Gravimetric Analysis (TGA), Scanning electron microscope (SEM).

ID: O47

Handmade Paper from Betel Nut Husk Fiber (*Areca Catechu* L.) And Old Newspaper

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Betel nut tree (*Areca catechu* L.) is one of palm species which is widespread in Indonesia. Generally, betel nut tree is used as farm barrier and its kernel is chewed along with betel leaf. This simple utilization needs to be expanded through exploring its potential. Betel nut husk fiber is one of fruit parts that contains 58,21% α-cellulose. High α-cellulose content of betel nut husk fiber can be utilized as raw material of handmade paper production. Handmade paper has coarse texture, visible fiber, and various color. Old newspaper was used as secondary fiber to improve physical properties of handmade paper. This study aimed to study the best proportion of betel nut husk fiber and old newspaper for handmade paper production based on tensile strength, stiffness, and bursting strength properties. The trial was arranged using a randomized block design with proportion of betel nut husk fiber and old newspaper as factor that has four level ratios (20:80, 40:60, 60:40, 80:20). The results showed proportion of betel nut husk fiber and old newspaper gave significant effects on the grammage, thickness, moisture content, color a*, color b*, and stiffness of handmade paper, while no significant effect was seen on the tensile strength and bursting strength. The composite o betel nut husk fiber and old newspaper with a ratio of 60:40 was found to be the best treatment of this study with 1,647 kN/m of tensile strength, 126,35 mNm of stiffness, and 169,13 kPa of bursting strength.

Keywords: Betel Nut Husk Fiber, Handmade Paper, Old Newspaper, Raw Materials Proportions

ID: O48

Bio-composite Based on Agriculture Biomass waste: Elaboration, Characterization and Applications in Food Packaging

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Currently, the smart packaging systems have been accrued a considerable attention due to their ultimate advantages namely contain food in a cost-effective way that satisfies industry requirements and consumer desires, increase the shelf life of foodstuff, maintains food safety, and minimizes environmental impact. In this study, the bio-composites materials were elaborated using novel non-toxic, and eco-friendly biological materials namely an agriculture biomass waste mixed with a functionalized biopolymer by an antibacterial agent. The antibacterial agents used in this work, were intercalated in the interlayer space of montmorillonite as type of clay and used to enhanced the biological properties of final composites. This composite was prepared as bilayer material, the first layer contains the paper sheets and the second one composes of biopolymer with antibacterial agent. The elaborated bio-composites were characterized using several techniques such as scanning electron microscope (SEM), Fourier-transform infrared spectroscopy (FTIR), mechanical, barrier properties as well as water vapor permeability. Also, their inhibitory effect against *Escherichia coli, Staphylococcus aureus*, and *Bacillus subtilis* were investigated. The present study suggest that the elaborated antibacterial food packaging paper can be used as potential bilayer material in smart packaging industry.

Keywords: Food industry, food paper, cellulose, agriculture biomass, antibacterial agents.