UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT AND CHARACTERIZATION OF OIL PALM (Elaeis guineensis Jacq.) EMPTY FRUIT BUNCH AND Saccharum officinarum BAGASSE FIBER BIOPHENOLIC HYBRID COMPOSITE INSULATION BOARD

NOR AZLINA BINTI RAMLEE

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By

NOR AZLINA BINTI RAMLEE

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

March 2022

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DEDICATION

To Al-Quran, the greatest source of knowledge
Surah Al-'Alaq. "Read in the name of your Lord Who created. He created man from a clot. Read and your Lord is the Most Honorable. Who taught by the pen. Taught man what he knew not." (Qur'an 96:1-5)
&
To my beloved father for his invaluable love, sacrifices, encouragements and support throughout my life
&
To my late mother, *Al-Fatihah*
&
To my beloved husband for his love, patience and understanding
&
To my awesome sisters and brothers

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

DEVELOPMENT AND CHARACTERIZATION OF OIL PALM (*Elaeis guineensis* Jacq.) EMPTY FRUIT BUNCH AND *Saccharum officinarum* BAGASSE FIBER BIOPHENOLIC HYBRID COMPOSITE INSULATION BOARD

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March 2022

Chairman : Mohammad Jawaid, PhD
Institute : Tropical Forestry and Forest Products

Recently, a high attention about concerning global warming and depletion of petrochemical based material reserves have become interest to many researchers to focus on the use of natural fibers as an alternative material for various industrial components. The abundant of biomass from natural fiber residue has attracted researchers to develop biodegradable, recyclable and eco-friendly composite to solve current environmental issue. The idea of this research is hybridizing oil palm empty fruit bunch (OPEFB) fiber and sugarcane bagasse (SCB) fiber with biophenolic resin as matrix to produce lightweight thermal insulation board for building applications. In preliminary study, the mechanical and physical properties of OPEFB and SCB single fiber were examined including the chemical composition analysis. Then, the effects of 2% silane, 4% hydrogen peroxide and combination 4% H_2O_2 and 2% silane (H_2O_2-silane) treatment on the mechanical, morphological, and structural properties of OPEFB and SCB fiber were studied with the aim to improve their compatibility with biophenolic resin. The influence of modified fibers content in composite was examined and the findings show the overall properties with 2% silane treatment were compatible with biophenolic matrix. Mechanical, structural, physical, thermal and acoustic properties of untreated and treated OPEFB:SCB fiber hybrid composite were investigated by maintaining the total fiber loading 50 wt% with different ratio of fiber applied which is 70:30 (7OPEFB:3SCB), 50:50 (5OPEFB5:5SCB) and 30:70 (3OPEFB:3SCB). For untreated composite analysis, 7OPEFB:3SCB hybrid composite display highest tensile strength and modulus, 5.56 MPa and 661.MPa respectively, 3OPEFB:7SCB hybrid composite show lower water absorption and thickness swelling, 5OPEFB:5SCB hybrid composite displayed better thermal stability with residue 45.04% and low thermal conductivity, 0.0863 W/mK, and in acoustic view untreated pure SCB composite has capability to conduct high frequency range, 3200Hz. The characterization of treatment composite show hybrid composite with 2% silane treatment and ratio 70:30 shows the highest improvement on tensile strength (11.67 MPa) and modulus (935.12 MPa). Hybridization both fiber with silane treatment

(ST), ST 5OPEFB:5SCB show highest flexural strength (16.82MPa) and compression strength (6.527 MPa) in comparison with 4% v/v hydrogen peroxide treated composite. TGA result shows hydrogen peroxide treatment (HT), HT 5OPEFB:5SCB was effective in thermal stability with 58% of residue at 500°C while silane treated, ST 5OPEFB:5SCB perform well in thermal conductivity analysis with 0.0542 W/mk. Sound absorption coefficient (α) was carried out according to ISO 10534-2:2001, and perform silane treatment; ST 5OPEFB:5SCB better to conduct up to 4250Hz with no air gap distance. The sound absorption coefficient were shifted to the left when the air gap applied. Morphological properties of the samples were carried using scanning electron microscopy (SEM) to observed fracture behavior and fiber pull out of the tensile fracture samples. Density, void content, water absorption and thickness swelling of the composite were also determine in this study. Based on the preliminary study, hybrid composite of silane treated fiber with ratio 50:50; ST 5OPEFB:5SCB presents excellent in overall properties among the others hybrid composite. In overall, the improvement of oil palm empty fruit bunch and sugarcane bagasse fiber behavior in natural fiber reinforced composite has great concern in advanced material building development. The characterization of biophenolic hybrid composite of ST 5OPEFB:5SCB has potentially effective as wall thermal insulation in building sector and future prospective usage.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBANGUNAN DAN PENCIRIAN TANDAN KELAPA SAWIT (*Elaeis guineensis* Jacq.) DAN HAMPAS GENTIAN TEBU (*Saccharum officinarum*) BIOFENOLIK HIBRID KOMPOSIT UNTUK PAPAN PENEBAT HABA

Oleh

NOR AZLINA BINTI RAMLEE

Mac 2022

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Sejak kebelakangan ini, isu pemanasan global dan penipisan sumber asli petrokimia menjadi tarikan dan keprihtainan dalam bidang-bidang penyelidikan. Hal ini telah memfokuskan perhatian penyelidik dalam penggunaan gentian semula jadi sebagai bahan alternative dalam kepelbagaian komponen bahan industri. Sumber biomas yang banyak dari sisa gentian semula jadi telah menarik minat penyelidik untuk membangunkan kajian terhadap komposit yang bersifat biodegradasi, boleh kitar semula dan mesra alam dan ianya bagi menyelesaikan masalah semasa terhadap alam sekitar. Oleh itu, idea penyelidikan ini adalah tentang hibridisasi gentian tandan kelapa sawit (OPEFB) dan gentian tebu (SCB) yang diperkukuh dengan resin biophenolik, ianya bertujuan untuk menghasilkan papan penebat haba ringan yang boleh di aplikasikan kegunaannya di dinding bangunan. Sifat mekanikal, fizikal dan analisa komposisi kimia gentian kosong tandan kelapa sawit (OPEFB) dan gentian tebu (SCB) telah di jalankan pada peringkat awal kajian. Kesan rawatan 2%v/v silane, 4%v/v hidrogen peroksida serta kombinasi 4% v/v H_2O_2 dan silane 2% v/v (H_2O_2-silane) terhadap sifat mekanikal, morfologi, dan struktur gentian kosong tandan kelapa sawit dan gentian tebu telah dikaji bagi tujuan meningkatkan keserasian terhadap resin biophenolik. Hasil kajian menunjukkan rawatan 2%v/v silane telah mempengaruhi dan mengubah komposisi gentian di dalam komposit yang diperkukuhkan dengan resin biophenolik. Selain itu, ciri-ciri mekanikal, struktur, fizikal, haba dan akustik hibrid komposit gentian tandan kelapa sawit kosong (OPEFB) dan gentian tebu (SCB) sebelum dan selepas rawatan telah di analisa dengan mengekalkan nisbah berat biophenolik sebanyak 50 wt%. Nisbah setiap gentian pada hybrid komposit yang dihasilkan adalah berbeza iaitu 70:30 (7OPEFB: 3SCB), 50: 50 (5OPEFB5: 5SCB) dan 30:70 (3OPEFB: 3SCB). Bagi analisis komposit yang tidak dirawat, sampel komposit hybrid 7OPEFB:3SCB menunjukkan kekuatan tegangan dan modulus tertinggi pada 5.56 MPa dan 661. MPa, manakala sampel komposit hibrid 3OPEFB:7SCB menunjukkan penyerapan air dan pembengkakan ketebalan yang lebih rendah. Komposit hybrid dengan nisbah 5OPEFB: 5SCB menunjukkan kestabilan haba yang lebih baik dengan sisa haba 45.04% dan haba

konductiviti yang rendah, 0,0863 W/m.K. Selain itu keputusan akustik komposit gentian tebu (SCB) tulen yang tidak dirawat mempunyai keupayaan untuk penyeraban bunyi pada julat frekuensi tinggi iaitu pada 3200Hz. Hibrid komposit dengan nisbah 70:30 yang telah dirawat dengan 2%v/v silane menunjukkan berlaku peningkatan tertinggi pada kekuatan tegangan (11.67 MPa) dan modulus (935.12 MPa). Manakala, hibridisasi kedua-dua gentian dengan rawatan silane (ST), ST 5OPEFB: 5SCB menunjukkan kekuatan lenturan lebih tinggi sebanyak 16.82MPa dan kekuatan mampatan 6.527 MPa berbanding dengan komposit yang dirawat hidrogen peroksida 4% v/v. Keputusan ujian analisa thermografik (TGA) menunjukkan rawatan hidrogen peroksida (HT), HT 5OPEFB: 5SCB berkesan dalam kestabilan terma dengan 58% sisa haba pada suhu 500°C sementara sampel hybrid komposit dengan rawatan silane, ST 5OPEFB: 5SCB menunjukkan prestasi yang baik dalam analisis konduktiviti haba dengan 0.0542 W/m.K. Selain itu, analisa koefisien penyerapan bunyi (α) tanpa ruang udara dan dengan ruang udara juga telah dijalankan berdasarkan ketetapan ISO 10534-2: 2001. Hibrid komposit ST 5OPEFB: 5SCB menunjukkan keputusan lebih baik pada frekuensi 4250Hz tanpa ruang udara. Manakala hasil analisa menunjukkan, koefisien penyerapan bunyi (α) akan beralih ke sebelah kiri iaitu ke kawasan frekuensi lebih rendah apabila perbezaan ruang udara (10mm, 20mm. 30mm) di kenakan. Sifat morfologi sampel dilakukan dengan menggunakan alat imbasan mikroskopi elektron (SEM) untuk mengkaji ujian kerapuhan dan menarik gentian sampel tegangan. Ciri-ciri ketumpatan, kandungan lompang, penyerapan air serta pembengkakan ketebalan komposit juga ditentukan dalam kajian ini. Berdasarkan kajian ini, komposit hibrid gentian yang dirawat dengan silane bernisbah 50:50; ST 5OPEFB: 5SCB telah menunjukkan sifat keseluruhan yang sangat baik di antara kesemua komposit hibrid yang lain. Secara keseluruhannya, peningkatan sifat gentian kosong tandan kelapa sawit dan gentian tebu semula jadi yang diperkukuh dengan resin biophenolik dilihat menjadi faktor penting dalam pembangunan teknologi bahan indutri pembinaan. Pencirian komposit hibrid dengan rawatan silane ,ST 5OPEFB: 5SCB diperkukuh dengan biophenolik dilihat berpotensi berkesan sebagai penebat haba dinding di sektor bangunan dan juga di masa hadapan.

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JazakAllahu khairan kathira.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

OPEFB	Oil palm empty fruit bunch
SCB	Sugarcane bagasse
ASTM	American Society for Testing and Materials
ISO	International Organization for Standardization
EN	European Stantards
RH	Relative humidity
TGA	Thermogravimetric analysis
FTIR	Fourier Transform Infrared
SEM	Scanning electron microscopy
NDF	Neutral detergent fiber
ADL	Acid detergent lignin
ADF	Acid detergent fiber
ATR	Attenuated total reflectance
H_2O_2	Hydrogen peroxide
MPOB	Malaysian Palm Oil Board
NRC	Noise reduction coefficient
SAC	Sound absorption coefficient

LIST OF SYMBOLS

cm	Centimeter
mm	Milimeter
mL	Mililiter
m	Meter
g	Gram
Hz	Hertz
h	Hour
α	Sound absorption coeffcient
ρ	Density
W	Watts
k	Thermal conductivity coeffcient
K	Kelvin
λ	Lambda, thermal conductivity
R	Rate of crosshead motion speed
L	Length
min	Minutes
d	Depth of beam
W_o	Weight of specimens after immersed in distilled water
W_d	Weight of specimens before immersed in distilled water
m	Mass
v	Volume
kN	Kilo newton
T_o	Thickness of specimens after immersed in distilled water

T_d	Thickness of specimens before immersed in distilled water.
Wf	Fiber weight fraction
Wm	Matrix weight fraction
ρf	Fiber density
τ	Interfacial shear strength
F	Force to maximum load/maximum stress
D	Diameter
MPa	Mega pascal
T	Tensile strength
A	Average fiber area in mm^2
°*C*	Degree celcius
wt%	Weight percent
rpm	Revolutions per minutes

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In modern building industry, thermal insulation it's seem very important in many aspects of life nowadays. Due to environmental considerations, modern buildings developed in Malaysia during the last few decades have lacked the necessary material for wall construction and enable to provides comfort condition to occupants (Nasir and Hassan, 2020; Rilling et al., 2006). Most of houses and building use air conditioners to cool the space in the house due to hot air at outside penetrate into the house. Indeed, previous study found around 15% to 25% heat gain to the wall area for an uninsulated home which are the house envelope is affected by three heat transfer methods known as conduction, convection and radiation (Dlimi et al., 2019; Keçebaş et al., 2011; Simona et al., 2017). The heats are produced by occupants and appliances of the house. Since the occupants used the appliances all day long, energy consumption and cost for electricity would rise simultaneously.

Therefore, according to (Aditya et al., 2017) a proper thermal insulation material technology would help in decreasing the rate of outside heat from transfers into the house in order to provide thermal comfort for building interior. An addition, insulation materials would help absorb the heat produce by occupants and appliances. Thus, this will cut cost on energy billing and also give comfort to the occupants (Kaynakli, 2012). Presently, the traditional insulation materials such as glass fiber, stone wool, expanded polystyrene, and polyurethane foam are commercially dominant in current market. These materials are efficient in maintaining thermal comfort to a building's interior, but most of it made with non-renewable resources and have a high embodied energy. Thus, from an environmental prospective lignocellulosic materials are highly promising reinforcement materials due to its origin, sustainability, biodegradability and waste management of industrial by-products (Dlimi et al., 2019; Laka et al., 2003; Liu et al., 2014).

In recent decades, most of researcher are widely utilized on development of natural fibers and agro-waste as composite such as sugar palm fiber (Shahroze et al., 2020), oil palm empty fruit bunch (Jawaid et al., 2013), pineapple leaf fiber (Asim et al., 2018a), rice husk, jute, coir fiber (Siakeng et al., 2018), sugarcane bagasse (Devadiga et al., 2020), flax and hemp reinforced with polymer as an insulation material. By having these agricultural crop residues for material development and fabrication, it's offers various beneficial in term of easy to handle, safe disposal at the end of service life, lightweight product, high mechanical strength, better thermal stability and acoustic properties, creation of pleasing environment and possible value addition to the agricultural products (Asim et al., 2019; Verma, Gope, Singh, & Jain, 2015).

On the basis of selection polymer matrix, it's depends on the requirements for specific applications in order to obtain the maximum performances. Previous studied found biopolymer like novalac phenol formaldehyde, polylactic acid, soy-oil based epoxy, starch, and polyester amide have a potential matrix for eco-friendly composite (Asim et al., 2018b; Mathew et al., 2005). Biophenolic resin worked as a thermal link between adjacent carbon fibers and enhanced thermal conductivity (Kim et al., 2007).

Biophenolic resin have a good characteristic in high mechanical bonding strength, better flexural and compressive strength, good in thermal and high flammability to the wood and fiber product (Asim et al., 2018b; Rashid et al., 2016). Presently, the biophenolic resins market is mainly driven by its demand from coatings, insulation, and lamination products, as well as adhesives and binder applications. It is thermosetting resins and categorize as a polymer of a comparatively low weight that easy to melt and mouldable. An addition, biophenolic resin are highly characterized a good chemical resistance, low toxicity, good heat resistance and dimensional stability for natural fiber fabricating purpose (Mahendran et al., 2013). Silane-treated cellulose fiber reinforced biophenolic composite increased its fiber-matrix bonding and tensile properties (Rojo et al., 2015).

The development of hybrid composite from renewable source as filler reinforcing materials in polymer has become interest of researcher in innovating the usage of materials with regards to sustainability. Hybrid composite insulation technology is an eco-friendly thermal insulation material made from combination two different agro waste reinforced with polymer matrix. Beneficially, it offers low in density, high mechanical properties, good thermal stability properties and has a low cost production. However, due to lack of expertise in its application and properties, this hybrid bio-composite insulation is not commercial and not widely used in comparison to more traditional insulation material.

In this research describes the potential of using natural fiber as an alternative of eco-friendly thermal insulation through hybridization of oil palm empty fruit bunch (OPEFB) and sugarcane bagasse (SCB) fiber. This research work focuses the characterization and development of untreated and treated OPEFB and SCB fiber. Then, the effect of hybridizing OPEFB and SCB fiber on mechanical, physical, morphological, thermal and acoustic behaviour for potential wall thermal insulation hybrid composite building applications has been evaluated.

1.2 Problem statements

Appealing synthetic materials such as glass fiber are not really pleasant when it comes to the matter of environment. Ali (2011) explained that natural fibers in composite can be applied in civil engineering for construction application such plastering, use as roofing material, slabs, boards, wall panelling systems, house construction and slope stabilization. Other than that, nowadays agriculture residue seen have large potential as a thermal protection and green material for thermal comfort in building sector in order to eliminated heat penetrate from outside to inside building (Almusaed and Almssad, 2016). The 'sustainability' concept nowadays introduced into the building design process encouraged researchers to develop thermal and acoustic thermal insulating materials as a result of using natural or recycled materials (Asdrubali et al., 2015).

Generally know Malaysia is the second largest producer of palm oil after Indonesia in Asia (May, 2012). According to previous research in 2014, the waste by-product from palm oil extraction process enormously could achieve 70–80 million tons per annum (Roslan et al., 2014).Which is in the palm oil mill, palm oil consists only 10% of the total biomass, while the rest 90% biomass are discarded as wastes (Awalludin et al., 2015). Year by year the yield of palm oil plantation in Malaysia kept increase and these residue problem tends to burden the environmental management with disposal difficulties challenges and escalates the operating cost. Generally, oil palm empty fruit bunch fibre is one of the biomass that is presently used as a fuel in the oil palm mills itself for generation of energy (Ooi, 2012). Other than that to convert the oil palm empty fruit bunch fibres into fertilizers for farms by burning them into ash. Thus, this raise the issue of environmental pollution generated due to uncontrolled burning of oil palm empty fruit bunch fibres in plantation area (Hassan et al., 2010)

The waste issue problem not only focus to palm oil plant but it is also happen with sugarcane industry. Sugarcane known as *Succharum officinarum* are easily found in Asia country and Malaysia have around 34500 acres total area of sugarcane plantation (Sapuan, 2014). Sugarcane industry generates large amounts of sugarcane bagasse especially in Perlis and Kedah. In the sugar industry, after the sugarcane is pressed to remove sucrose, the residue is called as sugarcane bagasse which contains highly fibrous residue. After the process of sucrose removal, the bags is generated and its accumulation presents as a waste problem for the sugar industry (Kadir and Maasom, 2013). From this environmental issue and increasing concern of disposal of agricultural residual creates me interest to explore the potential application of this biomass. Currently, the bagasse is used as a fuel for generate the steam (Sapuan, 2014).

Most of common existing building insulation material in market is normally produced from petrochemicals and synthetic compounds that have been processed with excessive energy usage. For example, polystyrene or known as styrofoam. Previous engineering found that polystyrene is transparent thermoplastic that available in several version; molded expanded polystyrene (MEPS), expanded polystyrene (EPS) and extruded polystyrene (XPS) type . Basically, most polystyrene foam insulation are low in cost but not environmental friendly. This type of polystyrene are loose fill in small beads are easy to flammable and need to be coated with fireproof chemical (Bipat, 2021). Others common insulation material in market are polyurethane foam, which is available in closed and open cell foams. This polyurethane insulation material are currently not achieved the optimum thermal conductivity performance including high density, pricey and non-environmental and human friendly which are commonly may cause allergic reactions in some people. An addition, it require the cells filled with a gas to expands the foam (Bipat, 2021).

Thus, the idea of sustainability was introduced into the building design process, which encouraged research into developing hybrid composite thermal insulating materials made from natural fiber agro-residue with optimum and low thermal conductivity performance. Oil palm empty fruit bunch and sugarcane bagasse fiber agriculture wastes are chosen in order to substitute the commercial thermal insulater from petrochemical (mainly polystyrene) source that possibly provide negative impact of thermal insulating and products on human health. Nonetheless, it is an ideal raw material in manufacturing new products for construction material because of its low fabricating costs and high quality green end material. Besides, today the lignocellulosic residue were widely used in the reinforcements in composite material with application in building industry (Nechita and Ionescu, 2018). Furthermore, it is ideal due to the fact that it is easily obtainable given the extensive of oil palm sector and sugar cane cultivation making its supply constant and stable in Malaysia (Cao et al., 2006b).

The selection of these two fibers as a components in making fiber thermal insulation board are based on possible to state that from the literature review the agriculture fiber which are natural fibre has good potential as reinforcement in thermoplastic and thermoset polymer composite mainly due to low density and high specific properties of fibers (Sapuan, 2014). Most of the time, natural fibres have their own unique characterization, composition and structures that are suitable to be used as reinforcements or fillers in polymer composite (Sapuan, 2014).

Scientifically studied by Danso (2017) oil palm fibers are porous, short in length and have varying diameter which affect the mechanical properties (Lee and Mariatti, 2008). An addition, oil palm fibers have low cellulose content as compare to coconut and bagasse fibers, which makes it easy to extraction process (Danso, 2017). From the previous analysis done, sugarcane bagasse fiber recorded the highest average length; 110mm and diameter 0.78mm while oil palm fiber had the least based on the 100 sample of fibers tested (Danso, 2017). Sugarcane fiber is used due to its properties as a natural filler reinforcement that has played an important role in enhancing the composite performance (Jeefferie et al., 2011). Panyakew and Fotios (2011) reported the thermal conductivity values of bagasse range from 0.046 to 0.068 W/mK depending on the density of the material (Jeefferie et al., 2011).

Flexural test were conducted and showed hybrid composite higher than OPEFB composite. The result in sandwich theory were interpreted in the study (Jawaid et al., 2010). Reis (2006) reported bagasse fibers are ideal candidates as a reinforcement material for construction materials since they have tensile strength between 170-290 MPa, modulus of elasticity between 15-19 MPa, with a fiber diameter of 0.2-0.4 mm. An addition, polymer matrix known as biophenolic resin has a good chemical resistance, good in mechanical properties and dimensional stability, thermal stability and flammability for natural fiber composite fabricating purpose (Asim et al., 2018b; Mahendran et al., 2013)

To overcome heat/hot air come in buildings and agriculture fiber residue problem, this research project focusing on development of thermal insulation material by using biomass from natural fiber for wall application. This project studied new hybrid composite from treated OPEFB and SCB fiber with biophenolic resin; which are no research studies before regarding on these combination these two fibers for produce lightweight hybrid composite as wall thermal insulation.

This study indirectly contribute technology in building material as one natural insulation that can minimize the heat transfer between outside and inside of building. These materials have purpose to save energy, protect and provide comfort to occupants in the building. A high attention is given in this current research to produce lightweight product with high performance on mechanical, thermal and and acoustic properties but low impact to environment and human health.

1.3 Research Objective

The research objectives of this study can be specified into:

i. To evaluate the effect of surface treatment on tensile, physical, structural morphological properties of oil palm empty fruit bunch (OPEFB) and sugarcane bagasse (SCB) fiber.
ii. To characterise the mechanical, physical, morphological properties of untreated oil palm empty fruit bunch/sugarcane bagasse fiber (OPEFB:SCB) reinforced biophenolic hybrid composite.
iii. To examine the thermal and acoustic properties of untreated oil palm empty fruit bunch/sugarcane bagasse (OPEFB:SCB) fiber reinforced biophenolic hybrid composite.
iv. To characterise the mechanical, physical, morphological properties of treated of oil palm empty fruit bunch/sugarcane bagasse (OPEFB:SCB) fiber hybrid composite.
v. To evaluate the effect of thermal and acoustic properties of treated oil palm empty fruit bunch/sugarcane bagasse (OPEFB:SCB) reinforced biophenolic hybrid composite.

1.4 Significance of Study

i. The findings of this study are expected to improve the knowledge in developing OPEFB:SCB reinforced biophenolic hybrid composite for wall thermal insulation building application.
ii. This goal have motivated the researchers to develop the green thermal insulation from abundant agriculture waste with improvise the properties in

current study, which is intended to help in addressing environmental issues related to the substitution petroleum based product.

iii. In term of hybrid composite field, it's highlights the beneficial of usage the natural fiber from agricultural residue could be improved by fiber modification such chemical surface treatments.

iv. In term of waste management issue facing every year from oil palm and sugarcane industry, this research provides platform for utilizing waste from agriculture residue into hybrid composite, which also transform waste into wealth.

v. This study show the ability of Asia country to develop green and safe insulating materials from oil palm empty fruit bunch and sugarcane bagasse fibers that would provide opportunities to improve the thermal comfort in the building.

1.5 Scope of Study

The scope of the current research work has been limited to experimental evaluation of mechanical, physical, thermal and acoustic properties of pure and treated oil plam empty fruit bunch (OPEFB)/sugarcane bagasse (SCB) fiber reinforced phenolic hybrid composite for a potential application eco-friendly wall building thermal insulation. The materials utilized for this study were limited to OPEFB, SCB and biophenolic resin. In this research, fiber surface modification of OPEFB and SCB was performed in various different treatments such as silane (2%), hydrogen peroxide (4%) and combination of hydrogen peropxide-silane (4-2%) for three hours under room temperature. These surface treatments were incorporated in order to improve the interfacial bonding between fibers and matrix by minimizing fiber's hydrophilicity. Pre-treatment of fibers seen affected their composition, which directly influences as well as those of composite too.

Numerous characterizations were carried out on pure and treated fibers and further investigated for the development of OPEFB/SCB reinforced biophenolic hybrid composite were evaluated. The composite were fabricated through handlay-up method by hot press moulding. The physical, mechanical, physical, morphological, thermal and acoustic properties of developed untreated and treated composite were examined. Based on previous literature survey on hybrid composite based on biophenolic, there is no work has been studied on combination of untreated and treated of OPEFB/SCB fiber hybrid composite. Oil palm and sugarcane plant are well known in Asia and easily found locally in Malaysia. Both abundant fibrous waste are rich with cellulose and the compatibility of both fibers to each other increase the properties of hybrid composite. Thus, with the combination of a good strength, thermal and acoustic properties of developed hybrid composite will extend the area of opportunity for construction industries to fabricate eco-friendly and safe building material product for wall thermal insulation.

1.6 Thesis Outline

This thesis has been structured into 10 chapters according to alternative thesis format of Universiti Putra Malaysia (UPM) based on publications on which each chapter (Chapter 2,4,5,6,7 and 8) contains its introduction, materials, results, discussion and conclusions. Brief description of each chapter has been addressed in the following section.

Chapter 1

This chapter highlighted the background of this research, problem statements, research objectives, significance and scope of the study with thesis outline.

Chapter 2

This chapter present literature review of natural fiber, mechanical, physical, thermal and acoustic characterization of OPEFB and SCB fiber reinforced polymeric composite, the properties of thermal insulator. This chapter also deals with the review article of natural composite, hybrid composite entitle of "Potential of oil palm empty fruit bunch (OPEFB) and sugarcane bagasse (SCB) fibers for thermal insulation application – A review".

Chapter 3

This chapter cover the information and the details of material and methodology which were being used in this research and their characterization.

Chapter 4 (Objective 1: Article 1)

This chapter present with the first objective supported by the first research article entitled of "Modification of oil palm empty fruit bunch and sugarcane bagasse biomass as potential reinforcement for composite panel and thermal insulation materials". This research work focused on the effect of chemical modification on single fiber of OPEFB and SCB. From the analysis, it show treated OPEFB fiber is enough to improve compatibility and mechanical properties, while treated SCB fiber was effective in thermal stability for fabrication of composite materials.

Chapter 5 (Objective 2: Article 2)

This chapter addresses the second objective supported by the second research manuscript entitle "Tensile, physical and morphological properties of oil palm empty fruit bunch/sugarcane bagasse fiber reinforced biophenolic hybrid composite". This study investigate the effect of untreated OPEFB and SCB fiber on tensile, physical and morphological behaviour of hybrid composite.

Chapter 6 (Objective 3: Article 3)

This chapter present the third objective supported by the third research article entitled "Evaluation of thermal and acoustic properties of oil palm empty fruit bunch/sugarcane bagasse fibers based hybrid composite for wall buildings thermal insulation". This research evaluated the effect of untreated OPEFB and SCB fiber on the thermal and acoustic properties of hybrid composite.

Chapter 7 (Objective 4: Article 4)

This chapter present the third objective supported by the fourth research article entitled "Effect of surface treatment on mechanical, physical and morphological properties of oil palm/bagasse fiber reinforced biophenolic hybrid composite for wall thermal insulation application"

Chapter 8 (Objective 5: Article 5)

This chapter addressed the fifth objective "Thermal and acoustic behavior of wall thermal insulation materials made of treatment fiber oil palm empty fruit bunch and sugarcane bagasse fiber". This study investigate the effect of treated OPEFB and SCB fiber on the thermal and acoustic properties of hybrid composite.

Chapter 9

This chapter presents the overall conclusions from the individual articles, overall study and future recommendations.

References

Abril D, Medina M, & Abril A. (2012) Sugar cane bagasse prehydrolysis using hot water. Brazilian *Journal of Chemical Engineeri*ng, 29(1), 31-38

Acharya SK, Mishra P, & Mehar S. K. (2011). Effect of surface treatment on the mechanical properties of bagasse fiber reinforced polymer composite. *BioResour*ces. 2011, 6, 3155-3165.

Agrawal R, Saxena NS, Sreekala MS, & Thomas S. (2000) Effect of treatment on the thermal conductivity and thermal diffusivity of oil-palm-fiber-reinforced phenolformaldehyde composites. *Journal of Polymer Science Part B: Polymer Physic*s. 38, 916-921.

Alwani MS, Khalil HA, Islam N, Sulaiman O, Zaidon A, & Dungani R. (2015). Microstructural study, tensile properties, and scanning electron microscopy fractography failure analysis of various agricultural residue fibers. *Journal of Natural Fibers*. 12, 154-68.

Anggono J. Sugondo S, Sewucipto S, Purwaningsih H, & Henrico S. (2017). The use of sugarcane bagasse in PP matrix composites: A comparative study of bagasse treatment using calcium hydroxide and sodium hydroxide on composite strength. In AIP Conference Proceedings, 2017 ,1788, 1, 030055. AIP Publishing.

Asdrubali F, D'Alessandro F, & Schiavoni S., (2015). A review of unconventional sustainable building insulation materials. Sustainable Materials and Technologies, 4, 1-7.

Asim Asim M, Jawaid M, Abdan K, & Ishak M.R. (2016). Effect of alkali and silane treatments on mechanical and fibre-matrix bond strength of kenaf and pineapple leaf fibres. *Journal of Bionic Engineering*, 13, 426-435.

Asim M, Jawaid M, Abdan K, & Nasir M. (2018). Effect of Alkali treatments on physical and Mechanical strength of Pineapple leaf fibres. In *IOP* Conference Series: Materials Science and Engineering, 290, 012030.

Atiqah A, Jawaid M, Ishak M.R, & Sapuan S.M. (2018). Effect of alkali and silane treatments on mechanical and interfacial bonding strength of sugar palm fibers with thermoplastic polyurethane. *Journal of Natural Fibers*, 15, 251-261.

Baltazar Baltazar-Y-Jimenez A, & Bismarck A. (2007). Surface modification of lignocellulosic fibres in atmospheric air pressure plasma. *Journal of Green Chemistry*, 9, 1057-1066.

Binici H, Eken M, Dolaz M, Aksogan O, & Kara M. (2014). An environmentally friendly thermal insulation material from sunflower stalk, textile waste and stubble fibres. *Construction and Building materials*, 51, 24-33.

Cao Y, Shibata S, & Fukumoto I. (2006). Fabrication and flexural properties of bagasse fiber reinforced biodegradable composites. *Journal of Macromolecular Science, Part B*, 45, 463-474.

Chandel AK, Antunes FA, Anjos V, Bell MJ, Rodrigues LN, Polikarpov I, de Azevedo ER, Bernardinelli OD, Rosa CA, Pagnocca FC, & da Silva S.S. (2014). Multi-scale structural and chemical analysis of sugarcane bagasse in the process of sequential acid–base pretreatment and ethanol production by Scheffersomyces shehatae and Saccharomyces cerevisiae. *Biotechnology for biofuels*, 7, 63.

Chen H., (2014). Chemical composition and structure of natural lignocellulose. Biotechnology of lignocellulose, *Springer,* Dordrecht, 25-71.

Chikhi M, Agoudjil B, Boudenne A, & Gherabli A. (2013). Experimental investigation of new biocomposite with low cost for thermal insulation. *Energy and Buildings,* 66, 267-273.

Colom X, Carrillo F, Nogués F, & Garriga P. (2003) Structural analysis of photodegraded wood by means of FTIR spectroscopy. *Journal of Polymer degradation and stability*, 80, 543-549.

Cruz G, Monteiro PA, Braz CE, Seleghin Jr P, Polikarpov I. &Crnkovic P.M. (2013) Thermal and morphological evaluation of chemically pretreated sugarcane bagasse. Int. J. Chem. Mol. Nucl. Mater. Metall. Eng.7, 435-440.

Dai, Z, Zhang B, Shi F, Li M, Zhang Z, & Gu Y. (2011). Effect of heat treatment on carbon fiber surface properties and fibers/epoxy interfacial adhesion. *Applied Surface Science*, 257, 8457-8461.

Danso, H., (2017). Properties of coconut, oil palm and bagasse fibres: as potential building materials. Procedia Engineering, 200, 1-9.

Fackler K, Stevanic JS, Ters T, Hinterstoisser B, Schwanninger M, & Salmén L. (2010). Localisation and characterisation of incipient brown-rot decay within spruce wood cell walls using FT-IR imaging microscopy. *Enzyme and microbial technology*, 47, 257-267.

Faix O, Bremer J, Schmidt O. & Tatjana S.J, (1991). Monitoring of chemical changes in white-rot degraded beech wood by pyrolysis—gas chromatography and Fourier-transform infrared spectroscopy. *Journal of Analytical and Applied Pyr*olysis, 21, 147-162.

Faizi, M. K., Shahriman, A. B., Majid, M. A., Ahmad, Z. A., Shamsul, B. M. T., & Ng, Y. G. (2017). The effect of alkaline treatments soaking time on oil palm empty fruit bunch (OPEFB) fibre structure. *In Journal of Physi*cs: Conference Series. IOP Publishing.

Fatra W, (2016). Effect of alkaline treatment on the properties of oil palm empty fruit bunch fiber-reinforced polypropylene composite. *International Journal of Technolog*y, 1026-1034.

Fatra W., Sanjaya R., Zulfansyah Z., Rionaldo H., & Helwani Z. (2015). Alkaline treatment of oil palm frond fibers by using extract of oil palm EFB ash for Better Adhesion toward Polymeric Matrix. *Journal of Engineering and Technological Sciences.* 47(5), 498-507.

Fatriasari W., Syafii W., Wistara N.J, Syamsu K, & Prasetya B. (2014). The characteristic changes of betung bamboo (Dendrocalamus asper) pretreated by fungal pretreatment. *International Journal of Renewable Energy Development*, 3, 133-143.

García -Hernández E, Licea-Claveríe A., Zizumbo A., Alvarez-Castillo A., & Herrera-Franco P.J. (2004). Improvement of the interfacial compatibility between sugar cane bagasse fibers and polystyrene for composites. *Polymer composites*, 25, 134-145.

Hossain M.K., Dewan M.W., Hosur M., & Jeelani S. (2011). Mechanical performances of surface modified jute fiber reinforced biopol nanophased green composites. *Composites Part B: Engineering.* 42, 1701-1707.

Indarti E., & Wanrosli W.D. (2015). Thermal Stability of Oil Palm Empty Fruit Bunch (OPEFB) Nanocrystalline Cellulose: Effects of post-treatment of oven drying and solvent exchange techniques. In *Journal of Physics*: Conference Series, 622, 012025.

Ishola M.M., Millati R., Syamsiah S., Cahyanto M.N., Niklasson C., & Taherzadeh M.J,.(2012). Structural changes of oil palm empty fruit bunch (OPEFB) after fungal and phosphoric acid pretreatment. *Molecules*, 17,14995-15012.

Jawaid M., Alothman O.Y, Paridah M.T, & Khalil H.S. (2014). Effect of oil palm and jute fiber treatment on mechanical performance of epoxy hybrid composites. *International Journal of Polymer Analysis and Characterization*, 62-9.

Jayamani E. Hamdan S, Rahman M.R, & Bakri M.K. (2014). Investigation of fiber surface treatment on mechanical, acoustical and thermal properties of betelnut fiber polyester composites. *Procedia Engineering*, 97, 545-554.

Koutsianitis D, Mitani C, Giagli K, Tsalagkas D, Halász K, Kolonics O, Gallis C, Csóka L. (2015). Properties of ultrasound extracted bicomponent lignocellulose thin films. Ultrasonics sonochemistry. 23, 148-55.

La Rosa A.D, Recca A, Gagliano A, Summerscales J, Latteri A, Cozzo G, & Cicala G. (2014). Environmental impacts and thermal insulation performance of innovative composite solutions for building applications. *Construction and Building Materials*, 55, 406-14.

Law K.N., Daud W.R, & Ghazali A. (2007). Morphological and chemical nature of fiber strands of oil palm empty-fruit-bunch (OPEFB). *BioResources*, 2, 351-362.

Li X, Tabil L G, Panigrahi S & Crerar W. J. (2006). The influence of fiber content on properties of injection molded flax fiber-HDPE biocomposites. ASAE Annual Meeting, American Society of Agricultural and Biological Engineers.

Manohar, K., & Manohar K (2012). Experimental investigation of building thermal insulation from agricultural by-products. British *Journal of Applied Science & Technology*, 2, 227.

Mohd NH, Alim A, Aqila A, Zahari JI, Yarmo MA, Ahmad I, Tahari A, Najiha M, Kargarzadeh H, Othaman R. Properties of aminosilane modified nanocrytalline cellulose

(NCC) from oil palm empty fruit bunch (OPEFB) fibers. In Materials Science Forum, 2017, 284-289.

Mohomane SM, Motaung TE, & Revaprasadu N. (2017), Thermal degradation kinetics of sugarcane bagasse and soft wood cellulose. *Materials*, 10, 1246.

Motaung T. E., & Mochane M. J. (2018). Systematic review on recent studies on sugar cane bagasse and bagasse cellulose polymer composites. *Journal of Thermoplastic Composite Materials*. 10,1416-1432.

Mothé C., & de Miranda I. (2009). Characterization of sugarcane and coconut fibers by thermal analysis and FTIR. *Journal of Thermal Analysis and Calorimetry*, 97, 661-665.

Mulinari DR, Cipriano JD, Capri MR, & Brandão A.T (2018). Influence of surgarcane bagasse fibers with modified surface on polypropylene composites. *Journal of Natural Fibers.* 15, 174-82.

Norsuraya S, Fazlena H, & Norhasyimi R. (2016). Sugarcane bagasse as a renewable Source of silica to synthesize Santa Barbara Amorphous-15 (SBA-15). *Procedia engineering*, 148, 839-846.

Onésippe C,Passe-Coutrin N, Toro F, Delvasto S, Bilba K, Arsène M.A (2010). Sugar cane bagasse fibres reinforced cement composites: thermal considerations. *Composites Part A: Applied Science and Manufacturing*, 4, 549-556.

Panyasart, K., Chaiyut N, Amornsakchai T., & Santawitee O. (2014)., Effect of surface treatment on the properties of pineapple leaf fibers reinforced polyamide 6 composites. *Energy procedia*, 56, 406-413.

Pereira P.H., Voorwald H.C, Cioffi M.O, Mullinari D.R, Da Luz S.M, & Da Silva M.L. (2011). Sugarcane bagasse pulping and bleaching: Thermal and chemical characterization. *BioResources*. 6, 2471-2482.

Poletto M., Dettenborn J., Pistor V., Zeni M., & Zattera A.J (2010). Materials produced from plant biomass: Part I: evaluation of thermal stability and pyrolysis of wood. *Materials Research*, 13, 375-379.

Puglia D., Monti M., Santulli C., Sarasini F, De Rosa IM & Kenny J.M. (2013). Effect of alkali and silane treatments on mechanical and thermal behavior of Phormium tenax fibers. *Fibers and Polymers*, 14, 423-427.

Pyun J.H, Shin T.B, Lee J.H, Ahn K.M, Kim T.H, & Cha H.S. (2016). Effects of hydrogen peroxide pretreatment and heat activation of silane on the shear bond strength of fiber-reinforced composite posts to resin cement. The *Journal of advanced prosthodontics*, 8, 94-100.

Rabelo S.C, Fonseca NA, Andrade RR, Maciel Filho R, & Costa A.C. (2011). Ethanol production from enzymatic hydrolysis of sugarcane bagasse pretreated with lime and alkaline hydrogen peroxide. *Biomass and bioe*nergy, 35, 2600-2607.

Rachini A, Le Troedec M, Peyratout C, & Smith A. (2009). Comparison of the thermal degradation of natural, alkali-treated and silane-treated hemp fibers under air and an inert atmosphere. *Journal of applied polymer science*. 112, 226-34.

Rayung M., Ibrahim N.A, Zainuddin N., Saad W.Z., Razak N.I, & Chieng B.W., (2014) The effect of fiber bleaching treatment on the properties of poly (lactic acid)/oil palm empty fruit bunch fiber composites. *International Journal of Molecular Sciences*, 15, 14728-14742.

Razak N.I, Ibrahim NA., Zainuddin N, Rayung M, Saad W.Z. (2014). The influence of chemical surface modification of kenaf fiber using hydrogen peroxide on the mechanical properties of biodegradable kenaf fiber/poly (lactic acid) composites. *Molecules*, 19, 2957-2968.

Rosli N.S., Harun S., Jahim J.M., & Othaman R. (2017). Chemical and physical characterization of oil palm empty fruit bunch. *Malaysian Journal of Analytical Sciences*, 21, 188-196.

Sair S, Oushabi A, Kammouni A, Tanane O, Abboud Y, Hassani FO, Laachachi A, & El Bouari A. (2017). Effect of surface modification on morphological, mechanical and thermal conductivity of hemp fiber: Characterization of the interface of hemp–Polyurethane composite. Case studies in thermal engineering, 10, 550-559.

Salam M.A, (2006). Effect of hydrogen peroxide bleaching onto sulfonated jute fiber. *Journal of Applied Polymer Scie*nce, 99, 3603-3607.

Sant'Anna C, & de Souza W. (2012). Microscopy as a tool to follow deconstruction of lignocellulosic biomass. Formatex Research Center, Espanha, 639-645.

Sawpan MA, Pickering K.L, & Fernyhough A. (2011). Effect of fibre treatments on interfacial shear strength of hemp fibre reinforced polylactide and unsaturated polyester composites. *Composites Part A: Applied Science and Manufacturing*, 42, 1189-1196.

Schwanninger M, Rodrigues J.C, Pereira H, & Hinterstoisser B. (2004). Effects of short-time vibratory ball milling on the shape of FT-IR spectra of wood and cellulose. Vibrational Spectroscopy, 36, 23-40.

Siyamak, S., Ibrahim N.A, Abdolmohammadi S, Yunus W.M, Rahman M.Z. (2012). Effect of fiber esterification on fundamental properties of oil palm empty fruit bunch fiber/poly (butylene adipate-co-terephthalate) biocomposites. International journal of molecular sciences, 2, 1327-1346.

Sreekala M.S., Kumaran M.G, & Thomas S. (1997). Oil palm fibers: Morphology, chemical composition, surface modification, and mechanical properties. *Journal of Applied Polymer Science*. 66, 821-835.

Vargas Betancur G.J., Pereira Jr. N. (2010). Sugar cane bagasse as feedstock for second generation ethanol production: Part I: Diluted acid pretreatment optimization. *Electronic Journal of Biotechno*logy, 3, 10-11.

Villain G., Thiery M, & Platret G. (2007). Measurement methods of carbonation profiles in concrete: Thermogravimetry, chemical analysis and gammadensimetry. Cement and Concrete Research, 37, 1182-1192.

Wong K.J., Yousif B.F, Low K.O. (2010). The effects of alkali treatment on the interfacial adhesion of bamboo fibres. Proceedings of the Institution of Mechanical Engineers, *Part L: Journal of Materials: Design and applications*. 224, 139-148.

Yarbrough D.W., Wilkes K.E, Olivier P.A, Graves R.S, &Vohra A. (2005). Apparent thermal conductivity data and related information for rice hulls and crushed pecan shells. Thermal Conductivity. 27, 222-30.

Yunus R, Salleh S.F, Abdullah N, & Biak D.R. (2010). Effect of ultrasonic pre-treatment on low temperature acid hydrolysis of oil palm empty fruit bunch. *Bioresource technology*. 101, 9792-9796.

Zafeiropoulos N.E., (2011) Interface engineering of natural fibre composites for maximum performance, Elsevier,.

References

Abdullah N & Sulaiman F. (2013). The oil palm wastes in Malaysia. In Biomass Now-Sustainable Growth and Use: InTech.

Aljuboori A.H. R. (2013). Oil palm biomass residue in Malaysia: availability and sustainability. International Journal Biomass Renew. 1(2):13-8.

Asim M, Saba N, Jawaid M, Nasir M, Pervaiz M, & Alothman O.Y. (2018). A Review on Phenolic Resin and its Composites. Current Analytical Chemistry. 14(3):185-97.

Atiqah A, Jawaid M, Sapuan SM, Ishak M.R. (2018). Mechanical and thermal properties of sugar palm fiber reinforced thermoplastic polyurethane composites: effect of silane treatment and fiber loading. *Journal of Renewable Materials*. 6(5):477-92.

Bakri M.K, Jayamani E, Heng SK, & Hamdan S. (2015). Reinforced oil palm fiber epoxy composites: An investigation on chemical treatment of fibers on acoustical, morphological, mechanical and spectral properties. *Materials Today: Proceedings.* 2(4-5):2747-56.

Doherty W, Halley P, Edye L, Rogers D, Cardona F, Park Y, & Woo T. (2007). Studies on polymers and composites from lignin and fiber derived from sugar cane. *Polymers for Advanced Technologies*. 18(8):673-8.

Fang T.W, Asyikin N, Syasya N.S, Shawkataly A.K., Kassim M.H, & Syakir M.I. (2017). Water Absorption and Thickness Swelling of Oil Palm Empty Fruit Bunch (OPEFB) and Seaweed Composite for Soil Erosion Mitigation. *Journal of Physical Science.* 28(2).

Fatra W., Rouhillahi H., Helwani Z., Zulfansyah, & Asmura J. (2016). Effect of alkaline treatment on the properties of oil palm empty fruit bunch fiber-reinforced polypropylene composite. *International Journal of Technology*. 7;1026–1034.

Hanan F, Jawaid M, & Md Tahir P. (2018). Mechanical performance of oil palm/kenaf fiber-reinforced epoxy-based bilayer hybrid composites. *Journal of Natural Fibers*.1-3.

Hassan A., Salema A..A, Ani FN, Bakar A.A. (2010)., A review on oil palm empty fruit bunch fiber-reinforced polymer composite materials. *Polymer Composites.* 31(12):2079-101.

Hill C.A, Abdul H.P. (2000). The effect of environmental exposure upon the mechanical properties of coir or oil palm fiber reinforced composites. *Journal of Applied Polymer Science*. 2000;77(6):1322-30.

Ibrahim N.A, Hashim N, Rahman MA, & Yunus W.Z. (2011). Mechanical properties and morphology of oil palm empty fruit bunch—polypropylene composites:

effect of adding ENGAGETM 7467. *Journal of Thermoplastic Composite Materials*. 24(5):713-32.

Jawaid M., Khalil H.A, Bakar A.A, Khanam P.N. (2011). Chemical resistance, void content and tensile properties of oil palm/jute fibre reinforced polymer hybrid composites. *Materials & Design*. 32(2):1014-9.

Jawaid M., Khalil H.A, Bakar A.A. (2010). Mechanical performance of oil palm empty fruit bunches/jute fibres reinforced epoxy hybrid composites. *Materials Science and Engineering: A*. 527(29-30):7944-9.

Jawaid M, Khalil H.A, & Bakar A.A. (2011). Woven hybrid composites: Tensile and flexural properties of oil palm-woven jute fibres based epoxy composites. *Materials Science and Engineering: A*. 528(15):5190-5.

Jawaid M., Khalil H.A, Khanam P.N, & Bakar A.A. (2011) Hybrid composites made from oil palm empty fruit bunches/jute fibres: Water absorption, thickness swelling and density behaviours. *Journal of Polymers and the Environment*.19(1):106-9.

Jawaid M., & Khalil H.A., (2011). Cellulosic/synthetic fibre reinforced polymer hybrid composites: A review. *Carbohydrate polymers*. 86(1):1-8.

John M.J, & Thomas S., (2008). Biofibres and biocomposites. *Carbohydrate polymers*. 71(3):343-64.

Johnson A.C, & Nordin Y.B., (2009). Particleboards from rice husk: a brief introduction to renewable materials of construction. Cellulose. 28:38.

Khalil H. S, Alwani M.S., & Omar A.K. (2007). Chemical composition, anatomy, lignin distribution, and cell wall structure of Malaysian plant waste fibers. BioResources. 1(2):220-32..

Lee S.C., & Mariatti M. (2008). The effect of bagasse fibers obtained (from rind and pith component) on the properties of unsaturated polyester composites. Materials Letters. 62(15):2253-6

Li Y., Hu C., & Yu Y. (2008). Interfacial studies of sisal fiber reinforced high density polyethylene (HDPE) composites. *Composites Part A: Applied Science and Manufacturing*. 39(4):570-8.

Liu L., Yu J, Cheng L., & Qu W. (2009). Mechanical properties of poly (butylene succinate)(PBS) biocomposites reinforced with surface modified jute fibre. *Composites Part A: Applied Science and Manufacturin*g. 40(5):669-74.

Luz S.M., Gonçalves A.R, Ferrão P.M, Freitas M.J, Leão A.L, & DelArco Jr A.P. (2007). Water absorption studies of vegetable fibers reinforced polypropylene composites. In Proceedings of 6th International Symposium on Natural Polymers and Composites.

Magzoub R., Osman Z, Tahir P, Nasroon TH, & Kantner W. (2015). Comparative evaluation of mechanical and physical properties of particleboard made from bagasse fibers and improved by using different methods. Cell Chem Technol. 49(5-6):537-42.

Mohanty A.K, Misra MA, & Hinrichsen G. (2000). Biofibres, biodegradable polymers and biocomposites: An overview. *Macromolecular materials and Engine*ering. 276(1):1-24.

Mokhena T.C, Mochane M.J, Motaung T.E, Linganiso L.Z, Thekisoe O.M, & Songca S.P. (2017). Sugarcane Bagasse and Cellulose Polymer Composites. In Sugarcane-Technology and Research. Intech Open.

Muñoz E., & García-Manrique J.A. (2015) Water absorption behaviour and its effect on the mechanical properties of flax fibre reinforced bioepoxy composites. *International Journal of Polymer Science*.

Nechita P., & Ionescu Ş.M. (2017). Investigation on the thermal insulation properties of lightweight biocomposites based on lignocellulosic residues and natural polymers. *Journal of Thermoplastic Composite Materials*.

Panyasart K., Chaiyut N., Amornsakchai T., & Santawitee O. (2014). Effect of surface treatment on the properties of pineapple leaf fibers reinforced polyamide 6 composites. *Energy procedia*. 56:406-13.

Puglia D., Biagiotti J., Kenny J.M. (2005). A review on natural fibre-based composites—Part II: Application of natural reinforcements in composite materials for automotive industry. *Journal of Natural Fibers*. 1(3):23-65.

Reddy N., & Yang Y. (2015). Fibers from Sugarcane Bagasse. In Innovative Biofibers from Renewable Resources 29-30. *Springer*, Berlin, Heidelberg.

Rozman H.D., Peng G.B, & Mohd Ishak Z.A. (1998). The effect of compounding techniques on the mechanical properties of oil palm empty fruit bunch–polypropylene composites. *Journal of Applied Polymer Sci*ence. 70(13):2647-55.

Safwan A., Jawaid M, Sultan M.T, & Hassan A. (2018). Preliminary study on tensile and impact properties of kenaf/bamboo fiber reinforced epoxy composites. *Journal of Renewable Materials*. 6(5):529-35.

Saheb D.N., & Jog J.P. (1999). Natural fiber polymer composites: a review. Advances in Polymer Technology: *Journal of the Polymer* Processing Institute. 18(4):351-63.

Saini G., Narula A.K., Choudhary V., & Bhardwaj R. (2010). Effect of particle size and alkali treatment of sugarcane bagasse on thermal, mechanical, and morphological properties of pvc-bagasse composites. *Journal of Reinforced Plastics and Composites.* 29(5):731-40.

Sreekala M.S, Kumaran M.G, Geethakumariamma M.L, & Thomas S. (2004) Environmental effects in oil palm fiber reinforced phenol formaldehyde composites: Studies on thermal, biological, moisture and high energy radiation effects. *Advanced Composite Materials*.13(3-4):171-97.

Sreekala M.S, Kumaran M.G, Joseph S., Jacob M., & Thomas S. (2000). Oil palm fibre reinforced phenol formaldehyde composites: influence of fibre surface modifications on the mechanical performance. *Applied Composite Material* 7(5-6):295–329.

Subramonian S., Ali A., Amran M., Sivakumar L.D, Salleh S., & Rajaizam A. (2016) Effect of fiber loading on the mechanical properties of bagasse fiber–reinforced polypropylene composites. *Advances in Mechanical Engineering*. 8(8):1687814016664258.

Tewari M., Singh V.K, Gope P.C, & Chaudhary A.K. (2012). Evaluation of mechanical properties of bagasse-glass fiber reinforced composite. *Journal Material Environment Science*, 3(1):171-84.

Vilay V., Mariatti M., Taib R.M., Todo M. (2008). Effect of fiber surface treatment and fiber loading on the properties of bagasse fiber–reinforced unsaturated polyester composites. *Composites Science and Technology*. 68(3-4):631-8.

Wambua P., Ivens J., & Verpoest I. (2003). Natural fibres: can they replace glass in fibre reinforced plastics?. *Composites Science and Technology*. 63(9):1259-64.

Wirawan R., Sapua S.M, Yunus R., & Abdan K. (2012). Density and water absorption of sugarcane bagasse-filled poly (vinyl chloride) composites. *Polymers & Polymer Composites.* 20(7):659.

Xie Y., Hill C.A, Xiao Z., Militz H., Mai C. (2010). Silane coupling agents used for natural fiber/polymer composites: A review. *Composites Part A: Applied Science and Manufacturing.* 41(7):806-19.

Yang H.S, Kim H.J, Son J., Park H.J, Lee B.J, Hwang T.S. (2004). Rice-husk flour filled polypropylene composites; mechanical and morphological study. *Composite structures*.63(3-4):305-12.

References

Agrawal R., Saxena N.S, Sharma K.B, Sreekala M.S, & Thomas S. (1999). Thermal conductivity and thermal diffusivity of palm fiber reinforced binary phenolformaldehyde composites.

Asdrubali F., Schiavoni S., & Horoshenkov K. (2012). A review of sustainable materials for acoustic applications. *Building Acoustics*, 19(4): p. 283-311.

Ashik K.P & Sharma R.S. (2015). A review on mechanical properties of natural fibre reinforced hybrid polymer composites. *Journal of minerals and materials characterization and engineering*. 3:420.

Ashour T., Wieland H., Georg H., Bockisch F.J, Wu W. (2010). The influence of natural reinforcement fibres on insulation values of earth plaster for straw bale buildings. *Materials & Design*. Dec 1;31:4676-85.

ASTM D5334-14. Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure, American Society for Testing and Materials. 2014.

Berardi U., & Iannace G. (2015). Acoustic characterization of natural fibers for sound absorption applications. *Building and Environment*. 94:840-52.

Binici H., Eken M., Kara M., & Dolaz M. (2013). An environment-friendly thermal insulation material from sunflower stalk, textile waste and stubble fibers. In 2013 International conference on renewable energy research and applications (ICRERA) Oct 20 (pp. 833-846). IEEE.10.1109/ICRERA.2013.6749868

Boopalan M., Niranjanaa M., & Umapathy M.J. (2013). Study on the mechanical properties and thermal properties of jute and banana fibre reinforced epoxy hybrid composites. *Composites Part B: Engineer*ing. Aug 1;51:54-7.

Buratti C., Belloni E, Lascaro E, Lopez G.A, & Ricciardi P. (2016). Sustainable panels with recycled materials for building applications: Environmental and acoustic characterization. *Energy Procedia*. 101: p. 972-979

Buratti C., Moretti E., Belloni E., & Agosti F. (2015). Thermal and acoustic performance evaluation of new basalt fiber insulation panels for buildings. *Energy Procedia*. Nov 1;78:303-8.

Carvalho S.T., Mendes L.M, Cesar A.A, Flórez J.B, Mori F.A, & Rabelo G.F. (2015). Acoustic characterization of sugarcane bagasse particleboard panels (Saccharum officinarum L). *Materials Research*. Aug;18(4):821-7.

Cha J., Seo J., & Kim S. (2012) Building materials thermal conductivity measurement and correlation with heat flow meter, laser flash analysis and TCi. Journal of thermal analysis and calorimetry. Jul 1;109(1):295-300.

Chen Y., Chen P., Hong C., Zhang B., & Hui D. (2013). Improved ablation resistance of carbon–phenolic composites by introducing zirconium diboride particles. *Composites Part B: Engineering.* Apr 1;47:320-5.

Cravo J.C, de Lucca Sartori D., Mármol G., Schmidt G.M, de Carvalho Balieiro J.C, & Fiorelli J. Effect of density and resin on the mechanical, physical and thermal performance of particleboards based on cement packaging. *Construction and Building Materials*. 2017 Oct 1;151:414-21.

da Silva Bertolini M., de Morais C.A., Christoforo A.L., Bertoli S.R, dos Santos W.N. , & Lahr F.A. (2019) Acoustic Absorption and Thermal Insulation of Wood Panels: Influence of Porosity. *BioResources*. Mar 22;14(2):3746-57.

Fang, W., Lu-cai, W., Jian-guo, W. Xiao-hong, Y. (2007). Sound absorption property of open-pore aluminium foams. China Foundry, 4: 31-33.

Forouharmajd F., & Mohammadi Z. (2018). Experimental Study on the Effect of Air Gap, Thickness, and Density on Acoustic Impedance and Sound Absorption of Stone Wool and Rubber Samples with Transfer Function Method. Iranian Journal of Science and Technology, Transactions of Mechanical Engineering. Mar 1;42(1):73-84.

Fouladi M.H, Ayub M, & Nor M.J. (2011). Analysis of coir fiber acoustical characteristics. *Applied Acoustics*. Jan 1;72(1):35-42.

Gupta M.K, Srivastava R.K, Kumar S, Gupta S, & Nahak B. (2015). Mechanical and water absorption properties of hybrid sisal/glass fibre reinforced epoxy composite. *American Journal of Polymer Science & Engineering*. Oct 27;3(2):208-19. http://www.ivyunion.org/index.php/ajpse

Indarti E., & Wanrosli W.D. (2015). Thermal stability of oil palm empty fruit bunch (OPEFB) nanocrystalline cellulose: Effects of post-treatment of oven drying and solvent exchange techniques. In Journal of Physics: Conference Series (Vol. 622, No. 1, p. 012025). IOP Publishing.

ISO 10534-2. (1998). Acoustics—Determination of Sound Absorption Coefficient and Impedance in Impedance Tubes—Part 331 2: Transfer-Function Method; International Organization for Standardization: Geneve, Switzerland.

JingFeng N., & GuiPing Z. (2016).Sound absorption characteristics of multilayer porous metal materials backed with an air gap. *Journal of Vibration and Control*. Jul;22:2861-72.

John M.J, & Thomas S. (2008). Biofibres and biocomposites. *Carbohydrate polymers*. Feb 8;71:343-64.

Kang C.W., Oh S.W, Lee T.B, Kang W., & Matsumura J. (2012). Sound absorption capability and mechanical properties of a composite rice hull and sawdust board. *Journal of Wood Science*. Jun;58:273-8.

Khedari J., Nankongnab N., Hirunlabh J, & Teekasap S. (2004). New low-cost insulation particleboards from mixture of durian peel and coconut coir. *Building and environment.* Jan 1;39(1):59-65

Koizumi T., Tsujiuchi N., & Adachi A. (2002). The development of sound absorbing materials using natural bamboo fibers. WIT Transactions on The Built Environment. Feb 25.

Latif E., Rhydwen G..R, Wijeyesekera D.C, Tucker S, Ciupala A, & Newport D. (2011). Thermal conductivity of building materials: an overview of its determination. Advances in Computing and Technology. 2011.

Lim Z.Y, Putra A., Nor M.J, & Yaakob M.Y. (2018). Sound absorption performance of natural kenaf fibres. *Applied Acoustics*. Jan 15;130:107-14.

Malawade U.A, & Jadhav M.G. (2020). Investigation of the Acoustic Performance of Bagasse. *Journal of Materials Research and Technology*. Jan 1;9(1):882-9.

Manohar K., Ramlakhan D., Kochhar G., Haldar S. (2006). Biodegradable fibrous thermal insulation. *Journal of the Brazilian Society of Mechanical Sciences and Engineering*. Mar;28(1):45-7.

Mateus R., Neiva S., Bragança L., Mendonça P., & Macieira M. (2013). Sustainability assessment of an innovative lightweight building technology for partition walls–comparison with conventional technologies. *Building and Environment*. Sep 1;67:147-59.

Morteza Mostashari S., & Fallah Moafi H. (2007). Thermogravimetric analysis of a cellulosic fabric incorporated with ammonium iron (II)-sulfate hexahydrate as a flame-retardant. *Journal of Industrial Textiles*. Jul;37(1):31-42.

MS 1498:1997. Standard for oil palm fibre SIRIM Berhad, Malaysia. 1997: p.1-3. Malaysian Standard. http://www.standardsmalaysia.gov.my/documents/

Muhammad M., Sa'at N, Naim H, Isa MC, Yussof N.H, & Yati M.S. (2012). The effect of air gap thickness on sound absorption coefficient of polyurethane foam. Def ST Tech Bull. 5(2):176-87.

Nagy B., Nehme S.G, & Szagri D. (2015). Thermal properties and modeling of fiber reinforced concretes. *Energy Procedia*. Nov 1;78:2742-7

Nor Azlina R., Jawaid M., Zainudin E.S., & Yamani S.A. (2019). Modification of Oil Palm Empty Fruit Bunch and Sugarcane Bagasse Biomass as Potential Reinforcement for Composites Panel and Thermal Insulation Materials. *Journal of Bionic Engineering*. Jan 1;16(1):175-88.

Nor Azlina R., Jawaid M., Zainudin E.S, & Yamani S.A. (2019). Tensile, physical and morphological properties of oil palm empty fruit bunch/sugarcane bagasse fibre reinforced phenolic hybrid composites. *Journal of Materials Research and Technology*. Jul 1;8(4):3466-74.

Papadopoulos A.M. (2005). State of the art in thermal insulation materials and aims for future developments. *Energy and buildings*. Jan 1;37(1):77-86.

Putra A., Abdullah Y., Efendy H., Farid W.M, Ayob M.R, & Py M.S. (2013). Utilizing sugarcane wasted fibers as a sustainable acoustic absorber. *Procedia Engineering*. 53:632-8.

Safwan A. I., Jawaid M., & Naveen J. (2019). Void Content, Tensile, Vibration and Acoustic Properties of Kenaf/Bamboo Fiber Reinforced Epoxy Hybrid Composites. *Materials*. Jan;12(13):2094

Sanjay M.R, & Siengchin S. (2019). Lightweight natural fiber composites. *Journal of Applied Agricultural Science and Technology*, 3(2): p. 178-178.

Shahzad A. (2012). Hemp fibre and its composites–a review. Journal of composite materials. 46(8):973-86.

Sreekala M.S, Kumaran M.G, Geethakumariamma M.L, & Thomas S. (2004). Environmental effects in oil palm fiber reinforced phenol formaldehyde composites: Studies on thermal, biological, moisture and high energy radiation effects. *Advanced Composite Materials*. Jan 1;13(3-4):171-97.

Sreekala M.S, Kumaran M.G, Joseph S, Jacob M, & Thomas S. (2000). Oil palm fibre reinforced phenol formaldehyde composites: influence of fibre surface modifications on the mechanical performance. *Applied Composite Materials*. Nov 1;7(5-6):295-329.

Trick K.A., & Saliba T.E. (1995). Mechanisms of the pyrolysis of phenolic resin in a carbon/phenolic composite. *Carbon*. Jan 1;33(11):1509-15.

Vilay V., Mariatti M., Taib R.M., & Todo M. (2008). Effect of fiber surface treatment and fiber loading on the properties of bagasse fiber–reinforced unsaturated polyester composites. *Composites Science and Technology*. Mar 1;68(3-4):631-8.

Yaakob M.Y., Haeryip Sihombing I.P, Jeefferie AR, Ahmad Mujahid AZ, Balamurugan A.G., & Norazman M.N. (2011). Optimization of coconut fibers toward heat insulator applications. Global engineers & technologists review. Sep 25;1(1):35-40.

Yashas G.T.G., Sanjay M.R., & Siengchin S. (2019). Natural fibers as sustainable and renewable resource for development of eco-friendly composites: a comprehensive review. *Frontiers in Materials*, 6:p.226.

Zhou X.Y.,Zheng F, Li H.G, & Lu CL.(2010). An environment-friendly thermal insulation material from cotton stalk fibers. *Energy and Buildings*. Jul 1;42:1070-4.

Zhou H., Li B., & Huang G. (2006). Sound absorption characteristics of polymer microparticles. *Journal of Applied Polymer Science*. 101(4): p. 2675-9.

References

Abdul Khalil, H.P.S., Siti Alwani, M., & Mohd Omar, A. (2007). Cell wall structure of various tropical plant waste fibers. *Journal of the Korean Wood Science and Technology, 35*(2), 9-15.

Abdul Khalil, H.P.S., Siti Alwani, M., Ridzuan, R., Kamarudin, H., & Khairul, A. (2008). Chemical composition, morphological characteristics, and cell wall structure of Malaysian oil palm fibers. *Polymer-Plastics Technology and Engineering, 47*(3), 273-280.

Adesina, O., Jamiru, T., Sadiku, E., Ogunbiyi, O., & Beneke, L. (2019). Mechanical evaluation of hybrid natural fiber–reinforced polymeric composite for automotive bumper beam: a review. *The International Journal Of Advanced Manufacturing Technology, 103*(5-8), 1781-1797.

Arif, M. F., Megat-Yusoff, P. S., & Ahmad, F. (2010). Effects of chemical treatment on oil palm empty fruit bunch reinforced high density polyethylene composite. *Journal of reinforced plastics and composite, 29*(14), 2105-2118.

Arpitha, G., & Yogesha, B. (2017). An overview on mechanical property evaluation of natural fiber reinforced polymers. *Materials Today: Proceedings, 4*(2), 2755-2760.

Asim, M., Jawaid, M., Abdan, K., & Ishak, M. R. (2016). Effect of alkali and silane treatments on mechanical and fiber-matrix bond strength of kenaf and pineapple leaf fibers. *Journal of Bionic Engineering, 13*(3), 426-435.

Asim, M., Paridah, M., Jawaid, M., Nasir, M., & Saba, N. (2018d). *Physical and flammability properties of kenaf and pineapple leaf fiber hybrid composite.* Paper presented at the IOP Conf Ser Mater Sci Eng.

Asim, M., Saba, N., Jawaid, M., Nasir, M., Pervaiz, M., & Alothman, O. Y. (2018g). A review on phenolic resin and its composite. *Current Analytical Chemistry, 14*(3), 185-197.

ASTM C209-98, Standard Test Methods for Cellulosic Fiber Insulating Board, ASTM International (1998), West Conshohocken, PA

ASTM D1037-12, Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials, ASTM International (2012), West Conshohocken, PA,

ASTM D2734-94,. Standard Test Methods for Void Content of Reinforced Plastics, ASTM International (1994), West Conshohocken, PA

ASTM D790-15, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, ASTM International (2015), West Conshohocken, PA

Atiqah, A., Jawaid, M., Sapuan, S., & Ishak, M. R. (2018c). Effect of surface treatment on the mechanical properties of sugar palm/glass fiber-reinforced thermoplastic polyurethane hybrid composite. *BioResources, 13*(1), 1174-1188.

Boopalan, M., Niranjanaa, M., & Umapathy, M. (2013). Study on the mechanical properties and thermal properties of jute and banana fiber reinforced epoxy hybrid composite. *Composite Part B: Engineering, 51*, 54-57.

Chua, P., Dai, S., & Piggott, M. (1992). Mechanical properties of the glass fiber-polyester interphase. *Journal of materials science, 27*(4), 913-918.

De Albuquerque, A., Joseph, K., de Carvalho, L. H., & d'Almeida, J. R. M. (2000). Effect of wettability and ageing conditions on the physical and mechanical properties of uniaxially oriented jute-roving-reinforced polyester composite. *Composite Science and Technology, 60*(6), 833-844.

Eng, C. C., Ibrahim, N. A., Zainuddin, N., Ariffin, H., Yunus, W. M., & Wan, Z. (2014). Impact strength and flexural properties enhancement of methacrylate silane treated oil palm mesocarp fiber reinforced biodegradable hybrid composite. *The Scientific World Journal, 2014*.

Fang, T. W., Asyikin, N., Syasya, N. S., Shawkataly, A. K. H., Kassim, M. H. M., & Syakir, M. (2017). Water Absorption and Thickness Swelling of Oil Palm Empty Fruit Bunch (OPEFB) and Seaweed Composite for Soil Erosion Mitigation. *Journal of Physical Science, 28*(2).

Feng, N. L., Malingam, S. D., Razali, N., & Subramonian, S. (2020). Alkali and Silane Treatments towards Exemplary Mechanical Properties of Kenaf and Pineapple Leaf Fiber-reinforced Composite. *Journal of Bionic Engineering, 17*, 380-392.

Idicula, M., Neelakantan, N., Oommen, Z., Joseph, K., & Thomas, S. (2005). A study of the mechanical properties of randomly oriented short banana and sisal hybrid fiber reinforced polyester composite. *Journal of applied polymer science, 96*(5), 1699-1709.

Islam, M. R., Gupta, A., Rivai, M., Beg, M. D. H., & Mina, M. F. (2016). Effects of fiber-surface treatment on the properties of hybrid composite prepared from oil palm empty fruit bunch fibers, glass fibers, and recycled polypropylene. *Journal of Applied Polymer Science, 133*(11).

Janne Pauline S, N., & Michael Angelo B, P. (2018). *Development of Abaca Fiber-reinforced Foamed Fly Ash Geopolymer.* Paper presented at the MATEC Web of Conferences.

Jappes, J. W., & Siva, I. (2011). Studies on the influence of silane treatment on mechanical properties of coconut sheath-reinforced polyester composite. *Polymer-plastics technology and engineering, 50*(15), 1600-1605.

Jawaid, M., Khalil, H. A., Bakar, A. A., & Khanam, P. N. (2011a). Chemical resistance, void content and tensile properties of oil palm/jute fiber reinforced polymer hybrid composite. *Materials & Design, 32*(2), 1014-1019.

Jawaid, M., Khalil, H. A., Khanam, P. N., & Bakar, A. A. (2011b). Hybrid composite made from oil palm empty fruit bunches/jute fibers: Water absorption, thickness swelling and density behaviours. *Journal of Polymers and the Environment, 19*(1), 106-109.

Khedari, J., Nankongnab, N., Hirunlabh, J., & Teekasap, S. (2004). New low-cost insulation particleboards from mixture of durian peel and coconut coir. *Building and environment, 39*(1), 59-65.

Madhu, P., Sanjay, M., Senthamaraikannan, P., Pradeep, S., Siengchin, S., Jawaid, M., & Kathiresan, M. (2020). Effect of various chemical treatments of prosopis juliflora fibers as composite reinforcement: physicochemical, thermal, mechanical, and morphological properties. *Journal of Natural Fibers, 17*(6), 833-844.

Maleque, M. A., Afdzaluddin, A., & Iqbal, M. (2012). *Flexural and impact properties of kenaf-glass hybrid composite.* Paper presented at the Advanced Materials Research.

Manimaran, P., Senthamaraikannan, P., Sanjay, M., Marichelvam, M., & Jawaid, M. (2018). Study on characterization of Furcraea foetida new natural fiber as composite reinforcement for lightweight applications. *Carbohydrate Polymers, 181*, 650-658.

Maruyama, S., Takagi, H., & Nakagaito, A. N. (2019). Influence Of Silane Treatment On Water Absorption And Mechanical Properties Of Pla/Short Bamboo Fiber-Reinforced Green Composite. *Wit Transactions on Engineering Sciences, 124*, 101-107.

Mitra, B. (2014). Environment friendly composite materials: biocomposite and green composite. *Defence Science Journal, 64*(3), 244.

Mohan, R., & Kishore. (1985). Jute-glass sandwich composite. *Journal of Reinforced plastics and composite, 4*(2), 186-194.

Munoz, E., & García-Manrique, J. A. (2015). Water absorption behaviour and its effect on the mechanical properties of flax fiber reinforced bioepoxy composite. *International journal of polymer science, 2015*

Nor Azlina, R., Jawaid, M., Edi Syams, Z., & Shaikh Abdul Karim, Y. (2019a). Modification of oil palm empty fruit bunch and sugarcane bagasse biomass as potential reinforcement for composite panel and thermal insulation materials. *Journal of Bionic Engineering, 16*(1), 175-188.

Nor Azlina, R., Jawaid, M., Edi Syams, Z., & Shaikh Abdul Karim, Y. (2019b). Tensile, physical and morphological properties of oil palm empty fruit bunch/sugarcane bagasse fiber reinforced phenolic hybrid composite. *Journal of Materials Research and Technology, 8*(4), 3466-3474.

Oliveira, P. R., Ribeiro Filho, S. L. M., Panzera, T. H., Christoforo, A. L., Durão, L. M. P., & Scarpa, F. (2020). Hybrid polymer composite made of sugarcane bagasse fibers and disposed rubber particles. *Polymers and Polymer Composite*, 0967391120943459.

Pásztory, Z., Horváth, T., Glass, S. V., & Zelinka, S. (2018). Experimental investigation of the influence of temperature on thermal conductivity of multilayer reflective thermal insulation. *Energy and Buildings, 174*, 26-30.

Piggott, M., & Harris, B. (1981). Compression strength of hybrid fiber-reinforced plastics. *Journal of Materials Science, 16*(3), 687-693.

Razak, N. I. A., Ibrahim, N. A., Zainuddin, N., Rayung, M., & Saad, W. Z. (2014). The influence of chemical surface modification of kenaf fiber using hydrogen peroxide on the mechanical properties of biodegradable kenaf fiber/poly (lactic acid) composite. *Molecules, 19*(3), 2957-2968.

Rowell, M., Han, J., & Rowell, J. (2001). Natural polymers and agrofibers composite fibers. *Journal of Plastic Composite, 31*, 21-23.

Safwan,A I., Jawaid, M., & Naveen, J. (2019). Void content, tensile, vibration and acoustic properties of kenaf/bamboo fiber reinforced epoxy hybrid composite. *Materials, 12*(13), 2094.

Sanal, I., & Verma, D. (2019). Construction Materials Reinforced with Natural Products (pp. 1-24): *Springer*: Basel, Switzerland.

Sanjay, M. R., & Siengchin, S. (2018). Natural fibers as perspective materials, KMUTNB: *International Journal Applied Science Technology*, 11, 233

Sant'Anna, C., & de Souza, W. (2012). Microscopy as a tool to follow deconstruction of lignocellulosic biomass. *Formatex Research Center, Espanha*, 639-645.

Sever, K., Sarikanat, M., Seki, Y., Erkan, G., & Erdoğan, Ü. H. (2010). The mechanical properties of γ-methacryloxypropyltrimethoxy silane-treated jute/polyester composite. *Journal of composite Materials, 44*(15), 1913-1924.

Sreekala, M., Kumaran, M., Joseph, S., Jacob, M., & Thomas, S. (2000). Oil palm fiber reinforced phenol formaldehyde composite: influence of fiber surface modifications on the mechanical performance. *Applied Composite Materials, 7*(5-6), 295-329.

Sydow, Z., & Bieńczak, K. (2018). The overview on the use of natural fibers reinforced composite for food packaging. *Journal of Natural Fibers.*

Takagi, H., Nakagaito, A. N., & Liu, K. (2014). *Natural fiber composite with low thermal conductivity*. Paper presented at the 8th Australasian Congress on Applied Mechanics: ACAM 8.

Thakur, V. K., Singha, A. S., Kaur, I., Nagarajarao, R. P., & Liping, Y. (2010). Silane functionalization of Saccaharum cilliare fibers: Thermal, morphological, and physicochemical study. *International Journal of Polymer Analysis and Characterization, 15*(7), 397-414.

Vidyashri, V., Lewis, H., Narayanasamy, P., Mahesha, G., & Bhat, K. S. (2019). Preparation of chemically treated sugarcane bagasse fiber reinforced epoxy composite and their characterization. *Cogent Engineering, 6*(1), 1708644.

Vilay, V., Mariatti, M., Taib, R. M., & Todo, M. (2008). Effect of fiber surface treatment and fiber loading on the properties of bagasse fiber–reinforced unsaturated polyester composite. *Composite Science and Technology, 68*(3-4), 631-638.

Xie, Y., Hill, C. A., Xiao, Z., Militz, H., & Mai, C. (2010). Silane coupling agents used for natural fiber/polymer composite: A review. *Composite Part A: Applied Science and Manufacturing, 41*(7), 806-819.

Xu, J., Sugawara, R., Widyorini, R., Han, G., & Kawai, S. (2004). Manufacture and properties of low-density binderless particleboard from kenaf core. *Journal of Wood Science, 50*(1), 62-67

Zhou, H., Sun, F., Li, H., Zhang, W., Cheng, H., Chen, L., Yu, Z., Chen, F. & Wang, G. (2019). Development and Application of Modular Bamboo-composite Wall Construction. *BioResources, 14*(3), 7169-7181.

Zhou, X.Y., Zheng, F., Li, H.G., & Lu, C.L. (2010). An environment-friendly thermal insulation material from cotton stalk fibers. *Energy and Buildings, 42*(7), 1070-1074.

References

Agrawal R., Saxena N.S, Sreekala M.S, & Thomas S. (2000). Effect of treatment on the thermal conductivity and thermal diffusivity of oil-palm-fiber-reinforced phenolformaldehyde composites. *Journal of Polymer Science Part B*: Polymer Physics. Apr 1;38(7):916-21.

Ahmad Saffian H., Talib M.A, Lee S.H, Md Tahir P, Lee C.H, Ariffin H.,& Asa'ari A.Z. (2020). Mechanical strength, thermal conductivity and electrical breakdown of Kenaf Core Fiber/lignin/polypropylene biocomposite. *Polymers*. Aug;12(8):1833.

Ali A.H, & Salih W.M. (2020). Manufacturing of Thermal and Acoustic Insulation From (Polymer Blend/Recycled Natural Fibers). *Engineering and Technology Journal*. Dec 25;38(12A):1801-7.

Allard J., & Atalla N. (2009). Propagation of sound in porous media: modelling sound absorbing materials 2e. *John Wiley & Sons* ;Oct 27.

Al-Oqla F.M, & Sapuan S. (2018) Natural fiber composites. Materials Selection. Jun 14.

Asdrubali F., D'Alessandro F., & Schiavoni S. (2015). A review of unconventional sustainable building insulation materials. *Sustainable Materials and Technologies*. Jul 1;4:1-7.

Asim M., Jawaid M, Paridah M.T, Saba N, Nasir M, & Shahroze R.M. (2019). Dynamic and thermo-mechanical properties of hybridized kenaf/PALF reinforced phenolic composites. *Polymer Composites.* Oct;40(10):3814-22.

Asim M., Paridah MT, Saba N, Jawaid M, Alothman OY, Nasir M, & Almutairi Z. (2018) Thermal, physical properties and flammability of silane treated kenaf/pineapple leaf fibres phenolic hybrid composites. *Composite Structures.* Oct 15;202:1330-8.

ASTM D5334-00. Standard test method for determination of thermal conductivity of soil and soft rock by thermal needle probe procedure. ASTM Data Ser. Publ.. 2008;5334:1-8.

Barczewski M., Matykiewicz D., & Szostak M. (2020). The effect of two-step surface treatment by hydrogen peroxide and silanization of flax/cotton fabrics on epoxy-based laminates thermomechanical properties and structure. *Journal of Materials Research and Technology*. Nov 1;9(6):13813-24.

Castagnede B., Aknine A., Brouard B., & Tarnow V. (2000). Effects of compression on the sound absorption of fibrous materials. Applied acoustics. Oct 1;61(2):173-82.

Chandramohan D., Sathish T, Kumar SD, & Sudhakar M. (2020).Mechanical and thermal properties of jute/aloevera hybrid natural fiber reinforced composites. In *AIP Conference Proceedings* Oct 29 (Vol. 2283, No. 1, p. 020084). AIP Publishing LLC.

Clyne T.W & Hull D. (2019) An introduction to composite materials. Cambridge University press; Jul 11.

Członka S, Strąkowska A, Pospiech P, & Strzelec K. (2020). Effects of chemically treated eucalyptus fibers on mechanical, thermal and insulating properties of polyurethane composite foams. *Materials*. Jan;13(7):1781.

Danihelová A, Němec M, Gergeľ T, Gejdoš M, Gordanová J, & Ščensný P (2019). Usage of recycled technical textiles as thermal insulation and an acoustic absorber. *Sustainability*. Jan;11(10):2968.

Devadiga D.G, Bhat KS, & Mahesha G.T. (2020). Sugarcane bagasse fiber reinforced composites: *Recent advances and applications*. Cogent Engineering Jan 1;7(1):1823159.

Dorez G, Taguet A, Ferry L, & Lopez-Cuesta J.M. (2013). Thermal and fire behavior of natural fibers/PBS biocomposites. *Polymer Degradation and Stability*.Jan 1;98(1):87-95.

Dungani R., Aditiawati P, Aprilia S, Yuniarti K, Karliati T, Suwandhi I, & Sumardi I (2018). Biomaterial from oil palm waste: properties, characterization and applications. Palm Oil. Jul 18;31.

Fouladi M.H, Ayub M, Nor MJ. (2011). Analysis of coir fiber acoustical characteristics. *Applied Acoustics*. Jan 1;72(1):35-42.

Fouladi M.H, Nor M.J, Ayub M, & Leman Z.A. (2010).Utilization of coir fiber in multilayer acoustic absorption panel. Applied Acoustics. Mar 1;71(3):241-9.

Fuentes CA, Brughmans G, Tran LQ, Dupont-Gillain C, Verpoest I, Van Vuure AW. Mechanical behaviour and practical adhesion at a bamboo composite interface: Physical adhesion and mechanical interlocking. Composites Science and Technology. 2015 Mar 10;109:40-7.

Georgescu S.V, & Cosereanu C. (2018). Comparative analysis of thermal and acoustic performance of composites made from wood fibres, recycled rubber and ABS. In IOP Conference Series: *Materials Science and Engineering.* Aug 1 (Vol. 399, No. 1, p. 012019). IOP Publishing.

Hassan T., Jamshaid H, Mishra R, Khan MQ, Petru M, Novak J, Choteborsky R, & Hromasova M. (2020). Acoustic, mechanical and thermal properties of green composites reinforced with natural fibers waste. *Polymers*. Mar;12(3):654.

Hidayat A., & Tachibana S.(2012) Characterization of polylactic acid (PLA)/kenaf composite degradation by immobilized mycelia of Pleurotus ostreatus. International Biodeterioration & Biodegradation. Jul 1;71:50-4.

Hossain S.I, Hasan M, Hasan M.N, & Hassan A. (2013). Effect of chemical treatment on physical, mechanical and thermal properties of ladies finger natural fiber. Advances in materials science and engineering. Jan 1;2013.

International Standard. Standard, B., Acoustics-Determination of Sound Absorption Coefficient and Impedance in Impedance Tubes—Part 2: Transfer-Function Method. BS EN ISO, 2001: p. 10534-2.

Ismail L, Ghazali MI, Mahzan S, & Zaidi A.A. (2010). Sound absorption of Arenga Pinnata natural fiber. World Academy of Science, Engineering and Technology.Jul 20;67:804-6.

Jawaid M., & Khalil H.A., Cellulosic/synthetic fibre reinforced polymer hybrid composites: A review. Carbohydrate polymers. 2011 Aug 1;86(1):1-8.

Jawaid M, Khalil HA, Bakar A.A,& Khanam P.N. (2011). Chemical resistance, void content and tensile properties of oil palm/jute fibre reinforced polymer hybrid composites. Materials & Design. Feb 1;32(2):1014-9.

Jayamani E., Soon K.H, Bakri M.K, & Hamdan S. (2017).Comparative study of sound absorption coefficients of coir/kenaf/sugarcane bagasse fiber reinforced epoxy composites. In Key Engineering Materials (Vol. 730, pp. 48-53). Trans Tech Publications Ltd.

Karthigairajan M., Nagarajan PK, Malarvannan RR, Bapu BR, Jayabalakrishnan D, Maridurai T, & Shanmuganathan VK. (2020). Effect of silane-treated rice husk derived biosilica on visco-elastic, thermal conductivity and hydrophobicity behavior of epoxy biocomposite coating for air-duct application. Silicon. Oct 16:1-0.

Karthikeyan A., & Balamurugan K. (2012) Effect of alkali treatment and fiber length on impact behavior of coir fiber reinforced epoxy composites.

Karwa R. (2020). One-Dimensional Steady-State Heat Conduction. In Heat and Mass Transfer 2020 (pp. 7-112). *Springer*.

Kumar S.S., Duraibabu D.A, & Subramanian K. Studies on mechanical, thermal and dynamic mechanical properties of untreated (raw) and treated coconut sheath fiber reinforced epoxy composites. *Materials & Design*. 2014 Jul 1;59:63-9.

Latif E., Rhydwen G.R, Wijeyesekera D.C, Tucker S, Ciupala A, & Newport D. (2011) Thermal conductivity of building materials: an overview of its determination. Advances in Computing and Technology.

Lertwattanaruk P., & Suntijitto A. (2015). Properties of natural fiber cement materials containing coconut coir and oil palm fibers for residential building applications. Construction and Building Materials. Sep 30;94:664-9.

Malawade U.A & Jadhav M.G. (2020). Investigation of the acoustic performance of bagasse. Journal of Materials Research and Technology. Jan 1;9(1):882-9.

Mamtaz H, Fouladi M.H, Al-Atabi M, & Narayana Namasivayam S. (2016). Acoustic absorption of natural fiber composites. *Journal of Engineering*. Jan 1;2016.

Matykiewicz D., Barczewski M, Mysiukiewicz O, Skórczewska K. (2021) Comparison of various chemical treatments efficiency in relation to the properties of flax, hemp fibers and cotton trichomes. *Journal of Natural Fibers*.May 4;18(5):735-51.

May C.Y. (2012). Malaysia: economic transformation advances oil palm industry. AOCS INFORM. Sep:1-8.

May-Pat A., Valadez-González A., & Herrera-Franco P.J (2013). Effect of fiber surface treatments on the essential work of fracture of HDPE-continuous henequen fiber-reinforced composites. Polymer Testing. Sep 1;32(6):1114-22.

Muhammad M., Sa'at N, Naim H, Isa M.C, Yussof N.H &Yati M.S. (2012). The effect of air gap thickness on sound absorption coefficient of polyurethane foam. Def ST Tech Bull. 5(2):176-87.

Nor Azlina R., Jawaid M., Ismail A.S, Zainudin E.S, & Yamani S.A. (2021). Evaluation of Thermal and Acoustic Properties of Oil Palm Empty Fruit Bunch/Sugarcane Bagasse Fibres Based Hybrid Composites for Wall Buildings Thermal Insulation. *Fibers and Polymers*. May 19:1-9.

Nor Azlina R., Jawaid M., Yamani S.A, Zainudin E.S, & Alamery S. (2021). Effect of surface treatment on mechanical, physical and morphological properties of oil palm/bagasse fiber reinforced phenolic hybrid composites for wall thermal insulation application. *Construction and Building Materials*. Mar 22;276:122239.

Nor Azlina R., Jawaid M., Zainudin E.S, & Yamani S.A. (2019). Modification of oil palm empty fruit bunch and sugarcane bagasse biomass as potential reinforcement for composites panel and thermal insulation materials. *Journal of Bionic Engineering*. Jan 1;16(1):175-88.

Nor Azlina R., Jawaid M., Zainudin ES, & Yamani SA. Tensile, physical and morphological properties of oil palm empty fruit bunch/sugarcane bagasse fibre reinforced phenolic hybrid composites. Journal of Materials Research and Technology. Jul 1;8(4):3466-74.

Nor Azlina R., Naveen J., & Jawaid M. (2020). Potential of oil palm empty fruit bunch (OPEFB) and sugarcane bagasse fibers for thermal insulation application–A review. Construction and Building Materials. Nov 24:121519.

Pickering K.L, Efendy M.A, & Le TM. (2016). A review of recent developments in natural fibre composites and their mechanical performance. Composites Part A: Applied Science and Manufacturing. Apr 1;83:98-112.

Razak N.I, Ibrahim N.A, Zainuddin N, Rayung M, & Saad W.Z. (2014). The influence of chemical surface modification of kenaf fiber using hydrogen peroxide on the mechanical properties of biodegradable kenaf fiber/poly (lactic acid) composites. Molecules. Mar;19(3):2957-68.

Rozli S.R, & Azmir N.A (2020). The Study on Acoustic Properties of Sugarcane Bagasse as Sound Absorber. *Advanced Research in Natural Fibers*. Dec 2;2(1):5-9.

Sair S., Oushabi A, Kammouni A., Tanane O., Abboud Y, & El Bouari A. (2018). Mechanical and thermal conductivity properties of hemp fiber reinforced polyurethane composites. Case studies in construction materials. Jun 1;8:203-12.

Samaei S.E., Mahabadi H.A, Mousavi S.M, Khavanin A., Faridan M, & Taban E. (2020). The influence of alkaline treatment on acoustical, morphological, tensile and thermal properties of Kenaf natural fibers. *Journal of Industrial Textiles*. Jul 3:1528083720944240.

Taiwo E.M, Yahya K., & Haron Z. (2019). Potential of using natural fiber for building acoustic absorber: A review. InJournal of Physics: Conference Series (Vol. 1262, No. 1, p. 012017). IOP Publishing.

Vijay R., Manoharan S, Arjun S, Vinod A, Singaravelu DL. Characterization of silane-treated and untreated natural fibers from stem of Leucas aspera. *Journal of Natural Fibers*. 2020 Jan 13:1-7.

Wang X, Petrů M. Effect of hygrothermal aging and surface treatment on the dynamic mechanical behavior of flax fiber reinforced composites. *Materials*. 2019 Jan;12(15):2376.

Yang H.S, Kim DJ, Kim HJ. Rice straw–wood particle composite for sound absorbing wooden construction materials. *Bioresource te*chnology. 2003 Jan 1;86(2):117-21.

Yang, W., & Li, Y. (2012). Sound absorption performance of natural fibers and their composite. *Science China Technological Sciences, 55*(8), 2278-2283.

Zaaba N.F., Jaafar M., & Ismail H. (2017). The effect of alkaline peroxide pre-treatment on properties of peanut shell powder filled recycled polypropylene composites. *Journal of Engineering Science*.13:75.

Zainal M., Santiagoo R., Ayob A, Ghani A.A, Mustafa W.A, & Othman N.S. (2020). Thermal and mechanical properties of chemical modification on sugarcane bagasse mixed with polypropylene and recycle acrylonitrile butadiene rubber composite. *Journal of Thermoplastic Composite Materials*. Nov;33(11):1533-54.

REFERENCES

Abas, R., Kamaruddin, M., Nordin, A. B. A., & Simeh, M. (2011). A study on the Malaysian oil palm biomass sector supply and perception of palm oil millers. *Oil Palm Industry Economic Journal, 11*(1), 28-41.

Abdul Khalil, H.P.S., Siti Alwani, M., & Mohd Omar, A. (2007). Cell wall structure of various tropical plant waste fibers. *Journal of the Korean Wood Science and Technology, 35*(2), 9-15.

Abdul Khalil, H.P.S., Siti Alwani, M., Ridzuan, R., Kamarudin, H., & Khairul, A. (2008). Chemical composition, morphological characteristics, and cell wall structure of Malaysian oil palm fibers. *Polymer-Plastics Technology and Engineering, 47*(3), 273-280.

Abdullah, N., & Sulaiman, F. (2013). The oil palm wastes in Malaysia *Biomass Now-Sustainable Growth and Use*: InTech.

Abdullah, N., Sulaiman, F., & Gerhauser, H. (2011). Characterisation of oil palm empty fruit bunches for fuel application. *J. Phys. Sci, 22*(1), 1-24.

Abril, D., Medina, M., & Abril, A. (2012). Sugar cane bagasse prehydrolysis using hot water. *Brazilian Journal of Chemical Engineering, 29*(1), 31-38.

Abu-Jdayil, B., Mourad, A.-H., Hittini, W., Hassan, M., & Hameedi, S. (2019). Traditional, state-of-the-art and renewable thermal building insulation materials: An overview. *Construction and Building materials, 214*, 709-735.

Acharya, S. K., Mishra, P., & Mehar, S. K. (2011). Effect of surface treatment on the mechanical properties of bagasse fiber reinforced polymer composite. *BioResources, 6*(3), 3155-3165.

Adesina, O., Jamiru, T., Sadiku, E., Ogunbiyi, O., & Beneke, L. (2019). Mechanical evaluation of hybrid natural fiber–reinforced polymeric composite for automotive bumper beam: a review. *The International Journal Of Advanced Manufacturing Technology, 103*(5-8), 1781-1797.

Aditya, L., Mahlia, T., Rismanchi, B., Ng, H., Hasan, M., Metselaar, H.S.C., Muraza, O. and Aditiya, H. (2017). A review on insulation materials for energy conservation in buildings. *Renewable and sustainable energy reviews, 73*, 1352-1365.

Agrawal, R., Saxena, N., Sharma, K. B., Sreekala, M., & Thomas, S. (1999). Thermal conductivity and thermal diffusivity of palm fiber reinforced binary phenolformaldehyde composite.

Agrawal, R., Saxena, N., Sreekala, M., & Thomas, S. (2000). Effect of treatment on the thermal conductivity and thermal diffusivity of oil-palm-fiber-reinforced phenolformaldehyde composite. *Journal of Polymer Science Part B: Polymer Physics, 38*(7), 916-921.

Agrawal, R., Saxena, N. S., Sharma, K. B., Thomas, S., & Sreekala, M. S. (2000). Activation energy and crystallization kinetics of untreated and treated oil palm fiber reinforced phenol formaldehyde composite. *Materials Science and Engineering: A, 277*(1-2), 77-82.

Agunsoye, J., & Aigbodion, V. (2013). Bagasse filled recycled polyethylene bio-composite: Morphological and mechanical properties study. *Results in Physics, 3*, 187-194.

Ahmad Saffian, H., Talib, M. A., Lee, S. H., Md Tahir, P., Lee, C. H., Ariffin, H., & Asa'ari, A. Z. M. (2020). Mechanical strength, thermal conductivity and electrical breakdown of Kenaf Core Fiber/lignin/polypropylene biocomposite. *Polymers, 12*(8), 1833.

Ahmed, A. Z., & Nayar, C. (2008). *Integrating sustainable energy in buildings: a case study in Malaysia.* Paper presented at the FAU Conference, Copenhagen, Denmark.

Ahuja, S., & Singh, D. (2011). A kinetic model of alkali catalyzed phenol-furfural novalac resinification. *Polymers and Polymer Composite*, *19*(7), 581-586.

Al-Mofleh, A., Taib, S., Mujeebu, M. A., & Salah, W. (2009). Analysis of sectoral energy conservation in Malaysia. *Energy, 34*(6), 733-739.

Al-Mosawi, A. I., Al-Maamori, M. H., & Wetwet, Z. A. (2012). Mechanical properties of composite material reinforcing by natural-synthetic fibers. *Academic Research International, 3*(3), 108.

Al-Oqla, F. M., & Sapuan, S. (2018). Natural fiber composite. *Materials Selection*.

Alabdulkarem, A., Ali, M., Iannace, G., Sadek, S., & Almuzaiqer, R. (2018). Thermal analysis, microstructure and acoustic characteristics of some hybrid natural insulating materials. *Construction and Building materials*, *187*, 185-196.

Alamri, H., & Low, I. M. (2012). Mechanical properties and water absorption behaviour of recycled cellulose fiber reinforced epoxy composite. *Polymer testing*, *31*(5), 620-628.

Ali, A. H., & Salih, W. M. (2020). Manufacturing of Thermal and Acoustic Insulation From (Polymer Blend/Recycled Natural Fibers). *Engineering and Technology Journal*, *38*(12A), 1801-1807.

Ali, M. (2011). Coconut fiber: A versatile material and its applications in engineering. *Journal of Civil Engineering and C onstruction Technology*, *2*(9), 189-197.

Ali, M. (2016). Microstructure, thermal analysis and acoustic characteristics of Calotropis procera (apple of sodom) fibers. *Journal of Natural Fibers, 13*(3), 343-352
.
Ali, M., Alabdulkarem, A., Nuhait, A., Al-Salem, K., Iannace, G., Almuzaiqer, R., Al-turki, A., Al-Ajlan, F., Al-Mosabi, Y. and Al-Sulaimi, A. (2020a). Thermal and acoustic characteristics of novel thermal insulating materials made of Eucalyptus Globulus leaves and wheat straw fibers. *Journal of Building Engineering*, 101452.

Ali, M., Alabdulkarem, A., Nuhait, A., Al-Salem, K., Almuzaiqer, R., Bayaquob, O., Salah, H., Alsaggaf, A and Algafri, Z. (2020b). Thermal Analyses of Loose Agave, Wheat Straw Fibers and Agave/Wheat Straw as New Hybrid Thermal Insulating Materials for Buildings. *Journal of Natural Fibers*, 1-16.

Ali, M. E.-S., & Zeitoun, O. M. (2012). Discovering and Manufacturing a New Natural Insulating Material Extracted From a Plant Growing Up in Saudi Arabia. *Journal of Engineered Fibers and Fabrics, 7*(4), 155892501200700405.

Ali, M. E., & Alabdulkarem, A. (2017). On thermal characteristics and microstructure of a new insulation material extracted from date palm trees surface fibers. *Construction and Building materials, 138*, 276-284.

Aljuboori, A. H. R. (2013). Oil palm biomass residue in Malaysia: availability and sustainability. *Int J Biomass Renew, 1*(2), 13-18.

Allard, J., & Atalla, N. (2009). *Propagation of sound in porous media: modelling sound absorbing materials 2e*: John Wiley & Sons.

Almusaed, A., & Almssad, A. (2016). *Insulation materials in context of sustainability*: BoD–Books on Demand.

Alwani, M. S., Khalil, H. A., Islam, N., Sulaiman, O., Zaidon, A., & Dungani, R. (2015). Microstructural study, tensile properties, and scanning electron microscopy fractography failure analysis of various agricultural residue fibers. *Journal of Natural Fibers, 12*(2), 154-168.

Aminudin, E., Khalid, N. H. A., Azman, N. A., Bakri, K., Din, M. F. M., Zakaria, R., & Zainuddin, N. A. (2017). *Utilization of baggase waste based materials as improvement for thermal insulation of cement brick.* Paper presented at the MATEC Web of Conferences.

Anggono, J., Sugondo, S., Sewucipto, S., Purwaningsih, H., & Henrico, S. (2017). *The use of sugarcane bagasse in PP matrix composite: A comparative study of bagasse treatment using calcium hydroxide and sodium hydroxide on composite strength.* Paper presented at the AIP Conference Proceedings.

Arbelaiz, A., Fernandez, B., Ramos, J., & Mondragon, I. (2006). Thermal and crystallization studies of short flax fiber reinforced polypropylene matrix composite: Effect of treatments. *Thermochimica Acta, 440*(2), 111-121.

Arbelaiz, A., Fernández, B., Valea, A., & Mondragon, I. (2006). Mechanical properties of short flax fiber bundle/poly (ε-caprolactone) composite: Influence of matrix modification and fiber content. *Carbohydrate Polymers, 64*(2), 224-232.

Arenas, J. P., & Crocker, M. J. (2010). Recent trends in porous sound-absorbing materials. *Sound & vibration, 44*(7), 12-18.

Arif, M. F., Megat-Yusoff, P. S., & Ahmad, F. (2010). Effects of chemical treatment on oil palm empty fruit bunch reinforced high density polyethylene composite. *Journal of reinforced plastics and composite, 29*(14), 2105-2118.

Arpitha, G., & Yogesha, B. (2017). An overview on mechanical property evaluation of natural fiber reinforced polymers. *Materials Today: Proceedings, 4*(2), 2755-2760.

Ascione, F., Bianco, N., De Masi, R. F., Mauro, G. M., Musto, M., & Vanoli, G. P. (2014). Experimental validation of a numerical code by thin film heat flux sensors for the resolution of thermal bridges in dynamic conditions. *Applied energy, 124,* 213-222.

Asdrubali, F., D'Alessandro, F., & Schiavoni, S. (2015). A review of unconventional sustainable building insulation materials. *Sustainable Materials and Technologies, 4,* 1-17.

Asdrubali, F., D'Alessandro, F., Baldinelli, G., & Bianchi, F. (2014). Evaluating in situ thermal transmittance of green buildings masonries—A case study. *Case Studies in Construction Materials, 1,* 53-59.

Asdrubali, F., Pisello, A., D'alessandro, F., Bianchi, F., Fabiani, C., Cornicchia, M., & Rotili, A. (2016). Experimental and numerical characterization of innovative cardboard based panels: Thermal and acoustic performance analysis and life cycle assessment. *Building and Environment, 95*, 145-159.

Asdrubali, F., Schiavoni, S., & Horoshenkov, K. (2012). A review of sustainable materials for acoustic applications. *Building Acoustics, 19*(4), 283-311.

Ashik, K., & Sharma, R. S. (2015). A review on mechanical properties of natural fiber reinforced hybrid polymer composite. *Journal of minerals and materials characterization and engineering, 3*(05), 420.

Ashour, T., Wieland, H., Georg, H., Bockisch, F.J., & Wu, W. (2010). The influence of natural reinforcement fibers on insulation values of earth plaster for straw bale buildings. *Materials & Design, 31*(10), 4676-4685.

Asim, M., Jawaid, M., Abdan, K., & Ishak, M. (2018e). The effect of silane treated fiber loading on mechanical properties of pineapple leaf/kenaf fiber filler phenolic composite. *Journal of Polymers and the Environment, 26*(4), 1520-1527.

Asim, M., Jawaid, M., Abdan, K., & Ishak, M. R. (2016). Effect of alkali and silane treatments on mechanical and fiber-matrix bond strength of kenaf and pineapple leaf fibers. *Journal of Bionic Engineering, 13*(3), 426-435.

Asim, M., Jawaid, M., Abdan, K., & Nasir, M. (2018b). *Effect of Alkali treatments on physical and Mechanical strength of Pineapple leaf fibers.* Paper presented at the IOP Conference Series: Materials Science and Engineering.

Asim, M., Jawaid, M., Nasir, M., & Saba, N. (2018c). Effect of fiber loadings and treatment on dynamic mechanical, thermal and flammability properties of pineapple leaf fiber and kenaf phenolic composite. *Journal of Renewable Materials, 6*(4), 383-393.

Asim, M., Jawaid, M., Paridah, M. T., Saba, N., Nasir, M., & Shahroze, R. M. (2019). Dynamic and thermo-mechanical properties of hybridized kenaf/PALF reinforced phenolic composite. *Polymer Composite, 40*(10), 3814-3822.

Asim, M., Paridah, M., Jawaid, M., Nasir, M., & Saba, N. (2018d). *Physical and flammability properties of kenaf and pineapple leaf fiber hybrid composite.* Paper presented at the IOP Conf Ser Mater Sci Eng.

Asim, M., Paridah, M., Saba, N., Jawaid, M., Alothman, O. Y., Nasir, M., & Almutairi, Z. (2018f). Thermal, physical properties and flammability of silane treated kenaf/pineapple leaf fibers phenolic hybrid composite. *Composite Structures, 202*, 1330-1338.

Asim, M., Saba, N., Jawaid, M., & Nasir, M. (2018a). Potential of natural fiber/biomass filler-reinforced polymer composite in aerospace applications *Sustainable composite for aerospace applications* (pp. 253-268): Elsevier.

Asim, M., Saba, N., Jawaid, M., Nasir, M., Pervaiz, M., & Alothman, O. Y. (2018g). A review on phenolic resin and its composite. *Current Analytical Chemistry, 14*(3), 185-197.

Asim, M., Jawaid, M., Abdan, K., Ishak, M. R., & Alothman, O. Y. (2018h). Effect of hybridization on the mechanical properties of pineapple leaf fiber/kenaf phenolic hybrid composite. *Journal of Renewable Materials*, *6*(1), 38-46.

ASTM C209-20, Standard Test Methods for Cellulosic Fiber Insulating Board. ASTM International (2020), West Conshohocken, PA,

ASTM D790-15, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, ASTM International (2015), West Conshohocken, PA,

ASTM D1037-12, Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials, ASTM International (2012), West Conshohocken, PA, ASTM D2734-94,. Standard Test Methods for Void Content of Reinforced Plastics, ASTM International (1994), West Conshohocken, PA

ASTM E1131-08, Standard Test Method for Compositional Analysis by Thermogravimetry, ASTM International (2008), West Conshohocken, PA

ASTM D5334-14, Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure, ASTM International (2014), West Conshohocken, PA

ASTM C177-13, Standard test method for steady state heat flax measurement and thermal transmission properties by means of guarded hot plate apparatus, , ASTM International (2013), West Conshohocken, PA

ASTM C423-09a, Standard test method for sound absorption and sound absorption coefficients by the reverberation room method, ASTM International (2009), West Conshohocken, PA

ASTM C518-10, Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus, ASTM International (2010), West Conshohocken, PA

ASTM C209-98, Standard Test Methods for Cellulosic Fiber Insulating Board, ASTM International (1998), West Conshohocken, PA

ASTM C384–04, Standard test method for impedance and absorption of acoustical materials by impedance tube method. ASTM International (2004), West Conshohocken, PA

ASTM C1029-15,Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation, ASTM International (2015), West Conshohocken, PA, 2015.

ASTM C578-18, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation, ASTM International (2018), West Conshohocken, PA

Atiqah, A., Jawaid, M., Ishak, M., & Sapuan, S. (2018a). Effect of alkali and silane treatments on mechanical and interfacial bonding strength of sugar palm fibers with thermoplastic polyurethane. *Journal of Natural Fibers, 15*(2), 251-261.

Atiqah, A., Jawaid, M., Sapuan, S., & Ishak, M. (2018b). Mechanical and thermal properties of sugar palm fiber reinforced thermoplastic polyurethane composite: effect of silane treatment and fiber loading. *Journal of Renewable Materials, 6*(5), 477-492.

Atiqah, A., Jawaid, M., Sapuan, S., & Ishak, M. R. (2018c). Effect of surface treatment on the mechanical properties of sugar palm/glass fiber-reinforced thermoplastic polyurethane hybrid composite. *BioResources, 13*(1), 1174-1188.

Australian Government Sound Absorption Panel. Available at: http:// jobaccess .gov.au/Advice/ProductOrSolutionOne/Pages/Sound_absorption_panels.aspx (accessed 26 July 2019).

Awalludin, M. F., Sulaiman, O., Hashim, R., & Nadhari, W. N. A. W. (2015). An overview of the oil palm industry in Malaysia and its waste utilization through thermochemical conversion, specifically via liquefaction. *Renewable and sustainable energy reviews*, *50*, 1469-1484.

Baharuddin, A. S., Yunos, N. S. H. M., Mahmud, N. A. N., Zakaria, R., & Yunos, K. F. M. (2012). Effect of high-pressure steam treatment on enzymatic saccharification of oil palm empty fruit bunches. *BioResources*, *7*(3), 3525-3538.

Bakar, A. A., Hassan, A., & Mohd Yusof, A. F. (2006). The effect of oil extraction of the oil palm empty fruit bunch on the processability, impact, and flexural properties of PVC-U composite. *International Journal of Polymeric Materials*, *55*(9), 627-641.

Bakar, N. N. A., Hassan, M. Y., Abdullah, H., Rahman, H. A., Abdullah, M. P., Hussin, F., & Bandi, M. (2015). Energy efficiency index as an indicator for measuring building energy performance: A review. *Renewable and sustainable energy reviews*, *44*, 1-11.

Bakri, M. K. B., Jayamani, E., Heng, S. K., & Hamdan, S. (2015). Reinforced oil palm fiber epoxy composite: An investigation on chemical treatment of fibers on acoustical, morphological, mechanical and spectral properties. *Materials Today: Proceedings*, *2*(4-5), 2747-2756.

Balaji, A., Karthikeyan, B., & Raj, C. S. (2014). Bagasse fiber–the future biocomposite material: a review. *International Journal of Cemtech Research*, *7*(1), 223-233.

Baldinelli, G., Asdrubali, F., Baldassarri, C., Bianchi, F., D’Alessandro, F., Schiavoni, S., & Basilicata, C. (2014). Energy and environmental performance optimization of a wooden window: A holistic approach. *Energy and buildings*, *79*, 114-131.

Baldinelli, G., & Bianchi, F. (2014). Windows thermal resistance: Infrared thermography aided comparative analysis among finite volumes simulations and experimental methods. *Applied energy*, *136*, 250-258.

Baltazar-Y-Jimenez, A., & Bismarck, A. (2007). Surface modification of lignocellulosic fibers in atmospheric air pressure plasma. *Green Chemistry*, *9*(10), 1057-1066.

Barczewski, M., Matykiewicz, D., & Szostak, M. (2020). The effect of two-step surface treatment by hydrogen peroxide and silanization of flax/cotton fabrics on epoxy-based laminates thermomechanical properties and structure. *Journal of Materials Research and Technology*, *9*(6), 13813-13824.

Benfratello, S., Capitano, C., Peri, G., Rizzo, G., Scaccianoce, G., & Sorrentino, G. (2013). Thermal and structural properties of a hemp–lime biocomposite. *Construction and Building materials, 48*, 745-754.

Berardi, U., & Iannace, G. (2015). Acoustic characterization of natural fibers for sound absorption applications. *Building and Environment, 94*, 840-852.

Bhingare, N. H., Prakash, S., & Jatti, V. S. (2019). A review on natural and waste material composite as acoustic material. *Polymer Testing, 80*, 106142.

Binici, H., Eken, M., Dolaz, M., Aksogan, O., & Kara, M. (2014). An environmentally friendly thermal insulation material from sunflower stalk, textile waste and stubble fibers. *Construction and Building materials, 51*, 24-33.

Binici, H., Eken, M., Kara, M., & Dolaz, M. (2013). *An environment-friendly thermal insulation material from sunflower stalk, textile waste and stubble fibers.* Paper presented at the 2013 International Conference on Renewable Energy Research and Applications (ICRERA).

Bipat, C., Common Insulation Materials Used in Buildings. New York Engineer. Retrieved from https://www.ny-engineers.com/blog/common-insulation-materials-used-in-buildings (accessed on 2021 February 7)

Bogoeva-Gaceva, G., Avella, M., Malinconico, M., Buzarovska, A., Grozdanov, A., Gentile, G., & Errico, M. (2007). Natural fiber eco-composite. *Polymer Composite, 28*(1), 98-107.

Boopalan, M., Niranjanaa, M., & Umapathy, M. (2013). Study on the mechanical properties and thermal properties of jute and banana fiber reinforced epoxy hybrid composite. *Composite Part B: Engineering, 51*, 54-57.

Boukhattem, L., Boumhaout, M., Hamdi, H., Benhamou, B., & Nouh, F. A. (2017). Moisture content influence on the thermal conductivity of insulating building materials made from date palm fibers mesh. *Construction and Building Materials, 148*, 811-823.

Buratti, C., Belloni, E., Lascaro, E., Lopez, G. A., & Ricciardi, P. (2016). Sustainable panels with recycled materials for building applications: Environmental and acoustic characterization. *Energy Procedia, 101*, 972-979.

Buratti, C., Moretti, E., Belloni, E., & Agosti, F. (2015). Thermal and acoustic performance evaluation of new basalt fiber insulation panels for buildings. *Energy Procedia, 78*, 303-308.

Cao, Y., Shibata, S., & Fukumoto, I. (2006a). Fabrication and flexural properties of bagasse fiber reinforced biodegradable composite. *Journal of Macromolecular Science, Part B, 45*(4), 463-474.

Cao, Y., Shibata, S., & Fukumoto, I. (2006b). Mechanical properties of biodegradable composite reinforced with bagasse fiber before and after alkali treatments. *Composite part A: Applied science and Manufacturing, 37*(3), 423-429.

Carvalho, S. T. M., Mendes, L. M., Cesar, A. A. d. S., Flórez, J. B., Mori, F. A., & Rabelo, G. F. (2015). Acoustic characterization of sugarcane bagasse particleboard panels (Saccharum officinarum L). *Materials Research, 18*(4), 821-827.

Carvalho, W., Canilha, L., Castro, P. F., & Barbosa, L. (2009). *Chemical Composition of the Sugarcane Bagasse.* Paper presented at the The 31st Symposium on Biotechnology for Fuels and Chemicals.

Castagnede, B., Aknine, A., Brouard, B., & Tarnow, V. (2000). Effects of compression on the sound absorption of fibrous materials. *Applied acoustics, 61*(2), 173-182.

Cerqueira, E., Baptista, C., & Mulinari, D. (2011). Mechanical behaviour of polypropylene reinforced sugarcane bagasse fibers composite. *Procedia Engineering, 10*, 2046-2051.

Cha, J., Seo, J., & Kim, S. (2012). Building materials thermal conductivity measurement and correlation with heat flow meter, laser flash analysis and TCi. *Journal of thermal analysis and calorimetry, 109*(1), 295-300.

Chai, L.-L., Zakaria, S., Chia, C. H., Nabihah, S., & Rasid, R. (2009). Physico-mechanical properties of PF composite board from EFB fibers using liquefaction technique.

Chandel, A. K., Antunes, F. A., Anjos, V., Bell, M. J., Rodrigues, L. N., Polikarpov, I., ., de Azevedo, E.R., Bernardinelli, O.D., Rosa, C.A., Pagnocca, F.C. and da Silva, S.S.,(2014). Multi-scale structural and chemical analysis of sugarcane bagasse in the process of sequential acid–base pretreatment and ethanol production by Scheffersomyces shehatae and Saccharomyces cerevisiae. *Biotechnology for biofuels, 7*(1), 63.

Chandramohan, D., Sathish, T., Kumar, S. D., & Sudhakar, M. (2020). *Mechanical and thermal properties of jute/aloevera hybrid natural fiber reinforced composite.* Paper presented at the AIP Conference Proceedings.

Chen, D., Li, J., & Ren, J. (2010). Study on sound absorption property of ramie fiber reinforced poly (L-lactic acid) composite: Morphology and properties. *Composite Part A: Applied Science and Manufacturing, 41*(8), 1012-1018.

Chen, H. (2014). Chemical composition and structure of natural lignocellulose *Biotechnology of lignocellulose* (pp. 25-71): Springer.

Chen, Y., Chen, P., Hong, C., Zhang, B., & Hui, D. (2013). Improved ablation resistance of carbon–phenolic composite by introducing zirconium diboride particles. *Composite Part B: Engineering, 47*, 320-325.

Chen, C., Wang, Z., Zhang, Y., Bi, M., Nie, K., & Wang, G. (2018). Investigation of the hydrophobic and acoustic properties of bio windmill palm materials. *Scientific Reports*, *8*(1), 1-8.

Chikhi, M., Agoudjil, B., Boudenne, A., & Gherabli, A. (2013). Experimental investigation of new biocomposite with low cost for thermal insulation. *Energy and buildings, 66*, 267-273.

Chua, P., Dai, S., & Piggott, M. (1992). Mechanical properties of the glass fiber-polyester interphase. *Journal of materials science, 27*(4), 913-918.

Clyne, T. W., & Hull, D. (2019). *An introduction to composite materials*: Cambridge university press.

Colom, X., Carrillo, F., Nogués, F., & Garriga, P. (2003). Structural analysis of photodegraded wood by means of FTIR spectroscopy. *Polymer degradation and stability, 80*(3), 543-549.

Cooper, I. (1999). Which focus for building assessment methods–environmental performance or sustainability? *Building Research & Information, 27*(4-5), 321-331.

Cordeiro, G. C., Toledo Filho, R. D., Tavares, L. M., & Fairbairn, E. d. M. R. (2009). Ultrafine grinding of sugar cane bagasse ash for application as pozzolanic admixture in concrete. *Cement and concrete research, 39*(2), 110-115.

Cravo, J. C. M., de Lucca Sartori, D., Mármol, G., Schmidt, G. M., de Carvalho Balieiro, J. C., & Fiorelli, J. (2017). Effect of density and resin on the mechanical, physical and thermal performance of particleboards based on cement packaging. *Construction and Building Materials, 151*, 414-421.

Cruz, G., Monteiro, P. A., Braz, C. E., Seleghin Jr, P., Polikarpov, I., & Crnkovic, P. M. (2013). Thermal and morphological evaluation of chemically pretreated sugarcane bagasse. *Int. J. Chem. Mol. Nucl. Mater. Metall. Eng, 7*, 435-440.

Członka, S., Strąkowska, A., Pospiech, P., & Strzelec, K. (2020). Effects of chemically treated eucalyptus fibers on mechanical, thermal and insulating properties of polyurethane composite foams. *Materials, 13*(7), 1781.

da Silva Bertolini, M., de Morais, C. A. G., Christoforo, A. L., Bertoli, S. R., dos Santos, W. N., & Lahr, F. A. R. (2019). Acoustic Absorption and Thermal Insulation of Wood Panels: Influence of Porosity. *BioResources, 14*(2), 3746-3757.

Dai, Z., Zhang, B., Shi, F., Li, M., Zhang, Z., & Gu, Y. (2011). Effect of heat treatment on carbon fiber surface properties and fibers/epoxy interfacial adhesion. *Applied Surface Science, 257*(20), 8457-8461.

Danihelová, A., Němec, M., Gergeľ, T., Gejdoš, M., Gordanová, J., & Sčensný, P. (2019). Usage of recycled technical textiles as thermal insulation and an acoustic absorber. *Sustainability, 11*(10), 2968.

Danso, H. (2017). Properties of coconut, oil palm and bagasse fibers: as potential building materials. *Procedia Engineering, 200*, 1-9.

De Albuquerque, A., Joseph, K., de Carvalho, L. H., & d'Almeida, J. R. M. (2000). Effect of wettability and ageing conditions on the physical and mechanical properties of uniaxially oriented jute-roving-reinforced polyester composite. *Composite Science and Technology, 60*(6), 833-844.

De Sousa, M., Monteiro, S., & d'Almeida, J. (2004). Evaluation of pre-treatment, size and molding pressure on flexural mechanical behavior of chopped bagasse–polyester composite. *Polymer testing, 23*(3), 253-258.

Demir, H., Atikler, U., Balköse, D., & Tıhmınlıoğlu, F. (2006). The effect of fiber surface treatments on the tensile and water sorption properties of polypropylene–luffa fiber composite. *Composite Part A: Applied Science and Manufacturing, 37*(3), 447-456.

Department of Energy, Office of Biological and Environmental Research. U.S, 2005.

Devadiga, D. G., Bhat, K. S., & Mahesha, G. (2020). Sugarcane bagasse fiber reinforced composite: Recent advances and applications. *Cogent Engineering, 7*(1), 1823159.

Dhakal, H., Zhang, Z., & Richardson, M. (2007). Effect of water absorption on the mechanical properties of hemp fiber reinforced unsaturated polyester composite. *Composite science and technology, 67*(7-8), 1674-1683.

DIN 4102-1, Fire behaviour of building materials and building components; building materials; concepts, requirements and tests, (1981), German Institute for Standardisation.

Dlimi, M., Iken, O., Agounoun, R., Zoubir, A., Kadiri, I., & Sbai, K. (2019). Energy performance and thickness optimization of hemp wool insulation and air cavity layers integrated in Moroccan building walls'. *Sustainable Production and Consumption, 20*, 273-288.

Doherty, W., Halley, P., Edye, L., Rogers, D., Cardona, F., Park, Y., & Woo, T. (2007). Studies on polymers and composite from lignin and fiber derived from sugar cane. *Polymers for Advanced Technologies, 18*(8), 673-678.

Doost-hoseini, K., Taghiyari, H. R., & Elyasi, A. (2014). Correlation between sound absorption coefficients with physical and mechanical properties of insulation boards made from sugar cane bagasse. *Composite Part B: Engineering, 58*, 10-15.

Dorez, G., Taguet, A., Ferry, L., & Lopez-Cuesta, J. (2013). Thermal and fire behavior of natural fibers/PBS biocomposite. *Polymer Degradation and Stability, 98*(1), 87-95.

Dungani, R., Aditiawati, P., Aprilia, S., Yuniarti, K., Karliati, T., Suwandhi, I., & Sumardi, I. (2018a). Biomaterial from oil palm waste: properties, characterization and applications. *Palm Oil, 31*.

Ebnesajjad, S., & Ebnesajjad, C. (2014). *Surface treatment of materials for adhesive bonding*, 301-329, William Andrew.

Economy J and Parkar Z (2011), 'Historical perspectives of phenolic resins', in: Strom E T and Rasmussen S C, *100+ Years of Plastics: Leo Backeland and Beyond*, *ACS Symposium Series*; American Chemical Society, Washington, DC

Eng, C. C., Ibrahim, N. A., Zainuddin, N., Ariffin, H., Yunus, W. M., & Wan, Z. (2014). Impact strength and flexural properties enhancement of methacrylate silane treated oil palm mesocarp fiber reinforced biodegradable hybrid composite. *The Scientific World Journal, 2014*.

Environment for development (2016), United Nation Environment Programmed, Nairobi, Kenya.

EN 12939, Thermal performance of building material and product, determination of thermal resistance by means of guarded hot plate and heat flow meter method - product of high and medium thermal resistance, (2000), European Standard

EN 12667, Thermal performance of building material and product, determination of thermal resistance by means of guarded hot plate and heat flow meter method - product of high and medium thermal resistance, (2001), European Standard.

EN 1602, Thermal insulating products for building applications. Determination of apparent density, (2013), European Standard

EN 12664, Thermal performance of building materials and products–determination of thermal resistance by means of guarded hot plate and heat flow meter methods–dry and moist products of medium and low thermal resistance, (2001), European Standard

Erwinsyah, E., & Richter, C. (2007). Thermal Insulation Material Made From Oil Palm Empty Fruit Bunch Fibers. *Biotropia*, *14*(1), 32-50.

Evon, P., Vandenbossche, V., Pontalier, P.-Y., & Rigal, L. (2014). New thermal insulation fiberboards from cake generated during biorefinery of sunflower whole plant in a twin-screw extruder. *Industrial Crops and Products*, *52*, 354-362.

Evon, P., Vinet, J., Rigal, M., Labonne, L., Vandenbossche, V., & Rigal, L. (2015). New insulation fiberboards from sunflower cake with improved thermal and mechanical properties.

Ewulonu, C. M., & Igwe, I. O. (2012). Properties of oil palm empty fruit bunch fiber filled high density polyethylene. *International Journal of Engineering and Technology, 3*(6), 2011-2012.

Fackler, K., Stevanic, J. S., Ters, T., Hinterstoisser, B., Schwanninger, M., & Salmén, L. (2010). Localisation and characterisation of incipient brown-rot decay within spruce wood cell walls using FT-IR imaging microscopy. *Enzyme and microbial technology, 47*(6), 257-267.

Faix, O., Bremer, J., Schmidt, O., & Tatjana, S. J. (1991). Monitoring of chemical changes in white-rot degraded beech wood by pyrolysis—gas chromatography and Fourier-transform infrared spectroscopy. *Journal of Analytical and Applied Pyrolysis, 21*(1-2), 147-162.

Faizi, M., Shahriman, A., Majid, M. A., Ahmad, Z., Shamsul, B., & Ng, Y. (2017). *The effect of alkaline treatments soaking time on oil palm empty fruit bunch (OPEFB) fiber structure.* Paper presented at the Journal of Physics: Conference Series.

Faizi, M., Shahriman, A., Majid, M. A., Shamsul, B., Ng, Y., Basah, S.N., Cheng, E.M., Afendi, M., Zuradzman, M.R., Wan, K. and Hazry, D., (2017). *An overview of the Oil Palm Empty Fruit Bunch (OPEFB) potential as reinforcing fiber in polymer composite for energy absorption applications.* Paper presented at the MATEC Web of Conferences.

Fang, T. W., Asyikin, N., Syasya, N. S., Shawkataly, A. K. H., Kassim, M. H. M., & Syakir, M. (2017). Water Absorption and Thickness Swelling of Oil Palm Empty Fruit Bunch (OPEFB) and Seaweed Composite for Soil Erosion Mitigation. *Journal of Physical Science, 28*(2).

Fang, W., Lu-cai, W., Jian-guo, W. Xiao-hong, Y. (2007). Sound absorption property of open-pore aluminium foams. China Foundry, 4: 31-33.

Faria, L. U. S., Pacheco, B. J. S., Oliveira, G. C., & Silva, J. L. (2020). Production of cellulose nanocrystals from pineapple crown fibers through alkaline pretreatment and acid hydrolysis under different conditions. *Journal of Materials Research and Technology, 9*(6), 12346-12353

Fathi, B., Foruzanmehr, M., Elkoun, S., & Robert, M. (2019). Novel approach for silane treatment of flax fiber to improve the interfacial adhesion in flax/bio epoxy composite. *Journal of Composite Materials, 53*(16), 2229-2238.

Fatra, W., Rouhillahi, H., Helwani, Z., Zulfansyah, & Asmura, J. (2016). Effect of Alkaline Treatment on the Properties of Oil Palm Empty Fruit Bunch Fiber-reinforced Polypropylene Composite. *International Journal Of Technology, 7*(6), 1026-1034.

Fatra, W., Sanjaya, R., Zulfansyah, Z., Rionaldo, H., & Helwani, Z. (2015). Alkaline Treatment of Oil Palm Frond Fibers by Using Extract of Oil Palm EFB Ash for Better Adhesion toward Polymeric Matrix. *Journal of Engineering and Technological Sciences, 47*(5), 498-507.

Fatriasari, W., Syafii, W., Wistara, N. J., Syamsu, K., & Prasetya, B. (2014). The Characteristic changes of betung bamboo (Dendrocalamus asper) pretreated by fungal pretreatment. *International Journal of Renewable Energy Development*, *3*(2), 133-143.

Feng, N. L., Malingam, S. D., Razali, N., & Subramonian, S. (2020). Alkali and Silane Treatments towards Exemplary Mechanical Properties of Kenaf and Pineapple Leaf Fiber-reinforced Composite. *Journal of Bionic Engineering*, *17*, 380-392.

Forouharmajd, F., & Mohammadi, Z. (2018). Experimental Study on the Effect of Air Gap, Thickness, and Density on Acoustic Impedance and Sound Absorption of Stone Wool and Rubber Samples with Transfer Function Method. *Iranian Journal of Science and Technology, Transactions of Mechanical Engineering*, *42*(1), 73-84.

Fouladi, M. H., Ayub, M., & Nor, M. J. M. (2011). Analysis of coir fiber acoustical characteristics. *Applied acoustics*, *72*(1), 35-42.

Fouladi, M. H., Nassir, M. H., Ghassem, M., Shamel, M., Peng, S. Y., Wen, S. Y., Xin, P.Z. and Nor, M.J.M., (2013). Utilizing Malaysian natural fibers as sound absorber *Modeling and Measurement Methods for Acoustic Waves and for Acoustic Microdevices*: Intechopen.

Fouladi, M. H., Nor, M. J. M., Ayub, M., & Leman, Z. A. (2010). Utilization of coir fiber in multilayer acoustic absorption panel. *Applied acoustics*, *71*(3), 241-249.

Fuentes, C., Brughmans, G., Tran, L., Dupont-Gillain, C., Verpoest, I., & Van Vuure, A. W. (2015). Mechanical behaviour and practical adhesion at a bamboo composite interface: Physical adhesion and mechanical interlocking. *Composite Science and Technology*, *109*, 40-47.

Fyhri, A., & Klæboe, R. (2009). Road traffic noise, sensitivity, annoyance and self-reported health—A structural equation model exercise. *Environment International*, *35*(1), 91-97.

Frollini, E., Silva, C. G., & Ramires, E. C. (2013). Phenolic resins as a matrix material in advanced fiber-reinforced polymer (FRP) composite. In *Advanced fiber-reinforced polymer (FRP) composite for structural applications* (pp. 7-43). Woodhead Publishing

García-Hernández, E., Licea-Claveríe, A., Zizumbo, A., Alvarez-Castillo, A., & Herrera-Franco, P. J. (2004). Improvement of the interfacial compatibility between sugar cane bagasse fibers and polystyrene for composite. *Polymer composite*, *25*(2), 134-145.

Gassan, J., & Bledzki, A. K. (1997). Effect of moisture content on the properties of silanized jute-epoxy composite. *Polymer Composite*, *18*(2), 179-184.

Gazagnes, E., Magniont, C., & Escadeillas, G. (2009). Matériau composite de construction incorporant de la chènevotte de chanvre. *Brevet FR*, *2*, 640.

Georgescu, S., & Cosereanu, C. (2018). *Comparative analysis of thermal and acoustic performance of composite made from wood fibers, recycled rubber and ABS.* Paper presented at the IOP Conference Series: Materials Science and Engineering.

Ghazilan, A. A., Mokhtar, H., Dawood, M. S., Aminanda, Y., & Ali, J. M. (2017). *Tensile Mechanical Property of Oil Palm Empty Fruit Bunch Fiber Reinforced Epoxy Composite*. Paper presented at the IOP Conference Series: Materials Science and Engineering.

Glass, J., Dainty, A. R., & Gibb, A. G. (2008). New build: materials, techniques, skills and innovation. *Energy Policy, 36*(12), 4534-4538.

Głowińska, E., Datta, J., & Parcheta, P. (2017). Effect of sisal fiber filler on thermal properties of bio-based polyurethane composite. *Journal of Thermal Analysis and Calorimetry, 130*(1), 113-122.

Gugliermetti, F., & Bisegna, F. (2007). Saving energy in residential buildings: The use of fully reversible windows. *Energy, 32*(7), 1235-1247.

Guimarães, J., Frollini, E., Da Silva, C., Wypych, F., & Satyanarayana, K. (2009). Characterization of banana, sugarcane bagasse and sponge gourd fibers of Brazil. *Industrial Crops and Products, 30*(3), 407-415.

Gupta, M., & Srivastava, R. (2016). Mechanical, thermal and water absorption properties of hybrid sisal/jute fiber reinforced polymer composite.

Hajiha, H., & Sain, M. (2015). The use of sugarcane bagasse fibers as reinforcements in composite *Biofiber reinforcements in composite materials* (pp. 525-549): Elsevier.

Hamzah, M. H., Deraman, R., & Saman, N. S. M. (2017). *Investigating the effectiveness of using agricultural wastes from empty fruit bunch (EFB), coconut fiber (CF) and sugarcane baggasse (SB) to produce low thermal conductivity clay bricks.* Paper presented at the AIP Conference Proceedings.

Hanan, F., Jawaid, M., & Md Tahir, P. (2018). Mechanical performance of oil palm/kenaf fiber-reinforced epoxy-based bilayer hybrid composite. *Journal of Natural Fibers*, 1-13.

Hanifi Binici, M. E., Mustafa Dolaz, Orhan Aksogan, Mehmet Kara. (2014). An environmentally friendly thermal insulation material from sunflower stalk, textile waste and stubble fibers. *Construction and Building Materials, 51*, 24-33.

Hariharan, A. B. A., & Khalil, H. A. (2005). Lignocellulose-based hybrid bilayer laminate composite: Part I-studies on tensile and impact behavior of oil palm fiber-glass fiber-reinforced epoxy resin. *Journal of Composite Materials, 39*(8), 663-684.

Hassan, A., Salema, A. A., Ani, F. N., & Bakar, A. A. (2010). A review on oil palm empty fruit bunch fiber-reinforced polymer composite materials. *Polymer Composite, 31*(12), 2079-2101.

Hassan, M. L., Rowell, R. M., Fadl, N. A., Yacoub, S. F., & Christainsen, A. W. (2000). Thermoplasticization of bagasse. II. Dimensional stability and mechanical properties of esterified bagasse composite. *Journal of Applied Polymer Science, 76*(4), 575-586.

Hassan, S., Tesfamichael, A., & Nor, M. M. (2014). *Comparison Study of Thermal Insulation Characteristics from Oil Palm Fiber.* Paper presented at the MATEC Web of Conferences.

Hassan, T., Jamshaid, H., Mishra, R., Khan, M. Q., Petru, M., Novak, J., Choteborsky, R and Hromasova, M. (2020). Acoustic, mechanical and thermal properties of green composite reinforced with natural fibers waste. *Polymers*, *12*(3), 654.

Hazrati-Behnagh, M., Zarea-Hosseinabadi, H., Daliri-Sosefi, M., Abginehchi, Z., & Hemmati, A. (2016). Mechanical and insulating performances of ultralight thick particleboard from sugarcane residues and woods planer shaving. *European Journal of Wood and Wood Products, 74*(2), 161-168.

Hidayat, A., & Tachibana, S. (2012). Characterization of polylactic acid (PLA)/kenaf composite degradation by immobilized mycelia of Pleurotus ostreatus. *International Biodeterioration & Biodegradation*, *71*, 50-54.

Hill, C., & Abdul, H. (2000). The effect of environmental exposure upon the mechanical properties of coir or oil palm fiber reinforced composite. *Journal of Applied Polymer Science*, *77*(6), 1322-1330.

Hill, C., & Abdul Khalil, H. (2000). Effect of fiber treatments on mechanical properties of coir or oil palm fiber reinforced polyester composite. *Journal of Applied Polymer Science*, *78*(9), 1685-1697.

Hoe, T. K., Sarmidi, M. R., Alwee, S. S. R. S., & Zakaria, Z. A. (2016). Recycling of oil palm empty fruit bunch as potential carrier for biofertilizer formulation. *Jurnal Teknologi*, *78*(2).

Hossain, M. K., Dewan, M. W., Hosur, M., & Jeelani, S. (2011). Mechanical performances of surface modified jute fiber reinforced biopol nanophased green composite. *Composite Part B: Engineering*, *42*(6), 1701-1707.

Hossain, S. I., Hasan, M., Hasan, M. N., & Hassan, A. (2013). Effect of chemical treatment on physical, mechanical and thermal properties of ladies finger natural fiber. *Advances in Materials Science and Engineering, 2013*.

Hossen, M. M., Feng, J., Yuxiang, Y., & Jiang, W. (2020). Preparation and evaluation mechanical, chemical and thermal properties of hybrid jute and coir fibers reinforced bio-composite using poly-lactic acid and poly-caprolactone blends. *Materials Research Express*, *7*(2), 025103.

Huang, X., Alva, G., Jia, Y., & Fang, G. (2017). Morphological characterization and applications of phase change materials in thermal energy storage: A review. *Renewable and Sustainable Energy Reviews, 72*, 128-145.

Huang, Z., Wang, N., Zhang, Y., Hu, H., & Luo, Y. (2012). Effect of mechanical activation pretreatment on the properties of sugarcane bagasse/poly (vinyl chloride) composite. *Composite Part A: Applied Science and Manufacturing, 43*(1), 114-120.

Hulme, J., & Radford, N. (2010). Sustainable Supply Chains That Support Local Economic Development. *Prince's Foundation for the Built Environment, 1*(1).

Ibrahim, N., Hashim, N., Rahman, M. A., & Yunus, W. Z. W. (2011). Mechanical properties and morphology of oil palm empty fruit bunch—polypropylene composite: effect of adding ENGAGETM 7467. *Journal of Thermoplastic Composite Materials, 24*(5), 713-732.

Ibrahim, S. H., Sia, W. K., Baharun, A., Nawi, M. N. M., & Affandi, R. (2014). Thermal performance of oil palm fiber and paper pulp as the insulation materials. *Journal of Civil Engineering, Science and Technology*, *5*(2), 22-28.

Idicula, M., Neelakantan, N., Oommen, Z., Joseph, K., & Thomas, S. (2005). A study of the mechanical properties of randomly oriented short banana and sisal hybrid fiber reinforced polyester composite. *Journal of applied polymer science, 96*(5), 1699-1709.

Indarti, E., & Wanrosli, W. (2015). *Thermal Stability of Oil Palm Empty Fruit Bunch (OPEFB) Nanocrystalline Cellulose: Effects of post-treatment of oven drying and solvent exchange techniques.* Paper presented at the Journal of Physics: Conference Series.

ISO 717-1, Acoustic rating of sound insulation in building and of building element, Part 1 - Airborne sound insulaton, (2013),

ISO 10534-2, Acoustics-Determination of Sound Absorption Coefficient and Impedance in Impedance Tubes-Part 2: Transfer-Function Method (2001), International Oganization for Standardization.

ISO 10534-2, Acoustics-Determination of Sound Absorption Coefficient and Impedance in Impedance Tubes-Part 2: Transfer-Function Method (1998), International Oganization for Standardization.

ISO 22007-1, Plastic- determination of thermal conductivity and thermal diffusivity - Part 1: general principles. (2009), International Oganization for Standardization.

ISO 11357-4 Plastic Differential scanning calorimetry (DSC). Determination of specific heat capacity, (2014), International Oganization for Standardization.

Ishola, M. M., Millati, R., Syamsiah, S., Cahyanto, M. N., Niklasson, C., & Taherzadeh, M. J. (2012). Structural changes of oil palm empty fruit bunch (OPEFB) after fungal and phosphoric acid pretreatment. *Molecules*, *17*(12), 14995-15012.

Islam, M. R., Gupta, A., Rivai, M., Beg, M. D. H., & Mina, M. F. (2016). Effects of fiber-surface treatment on the properties of hybrid composite prepared from oil palm empty fruit bunch fibers, glass fibers, and recycled polypropylene. *Journal of Applied Polymer Science*, *133*(11).

Islam, M., Yeng, C. M., Chun, K. S., & Huey, H. S. (2021). The influence of fiber orientation and chemical treatment on the performance of unsaturated polyester/chrysanthemum stem fiber composite. *Polymers and Polymer Composite*, *29*(8), 1103-1113.

Ismail, H., Rosnah, N., & Rozman, H. (1997). Effects of various bonding systems on mechanical properties of oil palm fiber reinforced rubber composite. *European polymer journal*, *33*(8), 1231-1238.

Ismail, L., Ghazali, M. I., Mahzan, S., & Zaidi, A. A. (2010). Sound absorption of Arenga Pinnata natural fiber. *World Academy of Science, Engineering and Technology*, *67*, 804-806.

Janne Pauline S, N., & Michael Angelo B, P. (2018). *Development of Abaca Fiber-reinforced Foamed Fly Ash Geopolymer.* Paper presented at the MATEC Web of Conferences.

Jappes, J. W., & Siva, I. (2011). Studies on the influence of silane treatment on mechanical properties of coconut sheath-reinforced polyester composite. *Polymer-plastics technology and engineering*, *50*(15), 1600-1605.

Jawaid, M., Abdul Khalil, H. P. S., & Abu Bakar, A. (2010). Mechanical performance of oil palm empty fruit bunches/jute fibers reinforced epoxy hybrid composite. *Materials Science and Engineering: A*, *527*(29), 7944-7949.

Jawaid, M., Alothman, O. Y., Paridah, M., & Khalil, H. S. A. (2014). Effect of oil palm and jute fiber treatment on mechanical performance of epoxy hybrid composite. *International Journal of Polymer Analysis and Characterization*, *19*(1), 62-69.

Jawaid, M., & Khalil, H. A. (2011d). Cellulosic/synthetic fiber reinforced polymer hybrid composite: A review. *Carbohydrate polymers*, *86*(1), 1-18.

Jawaid, M., Khalil, H. A., & Bakar, A. A. (2011c). Woven hybrid composite: Tensile and flexural properties of oil palm-woven jute fibers based epoxy composite. *Materials Science and Engineering: A*, *528*(15), 5190-5195.

Jawaid, M., Khalil, H. A., Bakar, A. A., Hassan, A., & Dungani, R. (2013). Effect of jute fiber loading on the mechanical and thermal properties of oil palm–epoxy composite. *Journal of Composite Materials*, *47*(13), 1633-1641.

Jawaid, M., Khalil, H. A., Bakar, A. A., & Khanam, P. N. (2011a). Chemical resistance, void content and tensile properties of oil palm/jute fiber reinforced polymer hybrid composite. *Materials & Design*, *32*(2), 1014-1019.

Jawaid, M., Khalil, H. A., Khanam, P. N., & Bakar, A. A. (2011b). Hybrid composite made from oil palm empty fruit bunches/jute fibers: Water absorption, thickness swelling and density behaviours. *Journal of Polymers and the Environment*, *19*(1), 106-109.

Jayamani, E., Hamdan, S., Kok Heng, S., Rahman, M. R., & Bin Bakri, M. K. (2016). Acoustical, thermal, and morphological properties of zein reinforced oil palm empty fruit bunch fiber bio-composite. *Journal of Applied Polymer Science*, *133*(43).

Jayamani, E., Hamdan, S., Rahman, M. R., & Bakri, M. K. B. (2014). Investigation of fiber surface treatment on mechanical, acoustical and thermal properties of betelnut fiber polyester composite. *Procedia Engineering*, *97*, 545-554.

Jayamani, E., Heng, S. K., bin Bakri, M. K., & Hamdan, S. (2017). *Comparative study of sound absorption coefficients of coir/kenaf/sugarcane bagasse fiber reinforced epoxy composite.* Paper presented at the Key Engineering Materials.

Jeefferie, A., Nurul Fariha, O., Mohd Warikh, A., Yuhazri, M., Sihombing, H., & Ramli, J. (2011). Preliminary study on the physical and mechanical properties of tapioca starch/sugarcane fiber cellulose composite. *Journal of Engineering and Applied Sciences*, *6*(4), 1819-6608.

Jelle, B. P. (2011). Traditional, state-of-the-art and future thermal building insulation materials and solutions–Properties, requirements and possibilities. *Energy and buildings*, *43*(10), 2549-2563

JingFeng, N., & GuiPing, Z. (2016). Sound absorption characteristics of multilayer porous metal materials backed with an air gap. *Journal of Vibration and Control*, *22*(12), 2861-2872.

John, M. J., & Thomas, S. (2008). Biofibers and biocomposite. *Carbohydrate polymers*, *71*(3), 343-364.

John, M. J., & Anandjiwala, R. D. (2008). Recent developments in chemical modification and characterization of natural fiber-reinforced composite. *Polymer composite*, *29*(2), 187-207.

Johnson, A. C., & Nordin, Y. B. D. E. D. (2009). Particleboards from rice husk: a brief introduction to renewable materials of construction. *Cellulose, 28*, 38.

Kadir, A. A., & Maasom, N. (2013). Recycling sugarcane bagasse waste into fired clay brick. *International Journal of Zero Waste Generation*, *1*(1), 21-26.

Kalam, A., Sahari, B., Khalid, Y., & Wong, S. (2005). Fatigue behaviour of oil palm fruit bunch fiber/epoxy and carbon fiber/epoxy composite. *Composite structures, 71*(1), 34-44.

Kalia, S., Kaith, B., & Kaur, I. (2009). Pretreatments of natural fibers and their application as reinforcing material in polymer composite—a review. *Polymer Engineering & Science, 49*(7), 1253-1272.

Kaliwon, J., Ahmad, S. S., & Aziz, A. A. (2009) Oil Palm Empty Fruit Bunch (Efb) As Energy Efficient Roofing Material.

Kang, C.-W., Oh, S.-W., Lee, T.-B., Kang, W., & Matsumura, J. (2012). Sound absorption capability and mechanical properties of a composite rice hull and sawdust board. *Journal of wood science, 58*(3), 273-278.

Karina, M., Onggo, H., Abdullah, A. D., & Syampurwadi, A. (2008). Effect of oil palm empty fruit bunch fiber on the physical and mechanical properties of fiber glass reinforced polyester resin. *Journal of Biological Sciences, 8*(1), 101-106.

Karthigairajan, M., Nagarajan, P., Malarvannan, R. R., Bapu, B. R., Jayabalakrishnan, D., Maridurai, T., & Shanmuganathan, V. (2020). Effect of silane-treated rice husk derived biosilica on visco-elastic, thermal conductivity and hydrophobicity behavior of epoxy biocomposite coating for air-duct application. *Silicon*, 1-10.

Karthikeyan, A., & Balamurugan, K. (2012). Effect of alkali treatment and fiber length on impact behavior of coir fiber reinforced epoxy composite.

Karwa, R. (2020). One-Dimensional Steady-State Heat Conduction *Heat and Mass Transfer* (pp. 7-112): Springer.

Kaynakli, O. (2012). A review of the economical and optimum thermal insulation thickness for building applications. *Renewable and sustainable energy reviews, 16*(1), 415-425.

Keçebaş, A., Kayfeci, M., & Gedik, E. (2011). Performance investigation of the Afyon geothermal district heating system for building applications: Exergy analysis. *Applied Thermal Engineering, 31*(6-7), 1229-1237.

Khalil, H. A., Jawaid, M., & Bakar, A. A. (2011). Woven hybrid composite: water absorption and thickness swelling behaviours. *BioResources, 6*(2), 1043-1052.

Khalil, H. A., Mahayuni, A. R., Rudi, D., Almulali, M., & Abdullah, C. (2012). Characterization of various organic waste nanofillers obtained from oil palm ash. *BioResources, 7*(4), 5771-5780.

Khalil, H. S. A., Alwani, M. S., & Omar, A. K. M. (2007). Chemical composition, anatomy, lignin distribution, and cell wall structure of Malaysian plant waste fibers. *BioResources, 1*(2), 220-232.

Khedari, J., Nankongnab, N., Hirunlabh, J., & Teekasap, S. (2004). New low-cost insulation particleboards from mixture of durian peel and coconut coir. *Building and environment, 39*(1), 59-65.

Kim, Y., Kamio, S., Tajiri, T., Hayashi, T., Song, S., Endo, M., . . . Dresselhaus, M. (2007). Enhanced thermal conductivity of carbon fiber/phenolic resin composite by the introduction of carbon nanotubes. *Applied Physics Letters, 90*(9), 093125.

Kodah, Z., Jarrah, M., & Shanshal, N. (1999). Thermal characterization of foam–cane (Quseab) as an insulant material. *Energy conversion and Management, 40*(4), 349-367.

Koizumi, T., Tsujiuchi, N., & Adachi, A. (2002). The development of sound absorbing materials using natural bamboo fibers. *WIT Transactions on The Built Environment, 59*.

Korjenic, A., Petránek, V., Zach, J., & Hroudová, J. (2011). Development and performance evaluation of natural thermal-insulation materials composed of renewable resources. *Energy and buildings, 43*(9), 2518-2523.

Koutsianitis, D., Mitani, C., Giagli, K., Tsalagkas, D., Halász, K., Kolonics, O., . . . Csóka, L. (2015). Properties of ultrasound extracted bicomponent lignocellulose thin films. *Ultrasonics sonochemistry, 23*, 148-155.

Ku, H., Wang, H., Pattarachaiyakoop, N., & Trada, M. (2011). A review on the tensile properties of natural fiber reinforced polymer composite. *Composite Part B: Engineering, 42*(4), 856-873.

Kumar, S. S., Duraibabu, D. a., & Subramanian, K. (2014). Studies on mechanical, thermal and dynamic mechanical properties of untreated (raw) and treated coconut sheath fiber reinforced epoxy composite. *Materials & Design, 59*, 63-69.

Kumaran, M., Sreekala, M., Joseph, S., Jacob, M., & Thomas, S. (2000). Oil palm fiber reinforce d phenol formaldehyde composite: influence of fiber surface modifications on th e mechanical performance. *Appl Compos Mater, 7*, 295-329.

Kushwaha, P. K., & Kumar, R. (2010). Effect of silanes on mechanical properties of bamboo fiber-epoxy composite. *Journal of reinforced plastics and composite, 29*(5), 718-724.

La Rosa, A., Recca, A., Gagliano, A., Summerscales, J., Latteri, A., Cozzo, G., & Cicala, G. (2014). Environmental impacts and thermal insulation performance of innovative composite solutions for building applications. *Construction and Building materials, 55*, 406-414.

Laborel-Préneron, A., Magniont, C., & Aubert, J.-E. (2018a). Characterization of barley straw, hemp shiv and corn cob as resources for bioaggregate based building materials. *Waste and biomass valorization, 9*(7), 1095-1112.

Laborel-Préneron, A., Magniont, C., & Aubert, J.-E. (2018b). Hygrothermal properties of unfired earth bricks: effect of barley straw, hemp shiv and corn cob addition. *Energy and buildings, 178*, 265-278.

Laka, M., Chernyavskaya, S., & Maskavs, M. (2003). Cellulose-containing fillers for polymer composite. *Mechanics of composite materials, 39*(2), 183-188.

Latif, E., Rhydwen, G., Wijeyesekera, D. C., Tucker, S., Ciupala, A., & Newport, D. (2011). Thermal conductivity of building materials: an overview of its determination. *Advances in Computing and Technology*.

Law, K.-N., Daud, W. R. W., & Ghazali, A. (2007). Morphological and chemical nature of fiber strands of oil palm empty-fruit-bunch (OPEFB). *BioResources, 2*(3), 351-362.

Lee, C. H., Khalina, A., & Lee, S. H. (2021). Importance of interfacial adhesion condition on characterization of plant-fiber-reinforced polymer composite: A review. *Polymers*, *13*(3), 438.

Lee, C. H., Sapuan, S. M., & Hassan, M. R. (2017). Mechanical and thermal properties of kenaf fiber reinforced polypropylene/magnesium hydroxide composite. *Journal of Engineered Fibers and Fabrics, 12*(2),

Lee, S., & Mariatti, M. (2008). The effect of bagasse fibers obtained (from rind and pith component) on the properties of unsaturated polyester composite. *Materials Letters*, *62*(15), 2253-2256.

Lertwattanaruk, P., & Suntijitto, A. (2015). Properties of natural fiber cement materials containing coconut coir and oil palm fibers for residential building applications. *Construction and Building Materials, 94*, 664-669.

Li, Y., Hu, C., & Yu, Y. (2008). Interfacial studies of sisal fiber reinforced high density polyethylene (HDPE) composite. *Composite Part A: Applied Science and Manufacturing, 39*(4), 570-578.

Lim, Z., Putra, A., Nor, M., & Yaakob, M. (2018). Sound absorption performance of natural kenaf fibers. *Applied Acoustics*, *130*, 107-114.

Liu, L., Yu, J., Cheng, L., & Qu, W. (2009). Mechanical properties of poly (butylene succinate)(PBS) biocomposite reinforced with surface modified jute fiber. *Composite Part A: Applied Science and Manufacturing*, *40*(5), 669-674.

Liu, R., Peng, Y., Cao, J., & Chen, Y. (2014). Comparison on properties of lignocellulosic flour/polymer composite by using wood, cellulose, and lignin flours as fillers. *Composite Science and Technology*, *103*, 1-7.

Loh, Y., Sujan, D., Rahman, M. E., & Das, C. A. (2013). Sugarcane bagasse—The future composite material: A literature review. *Resources, Conservation and Recycling, 75*, 14-22.

Luz, S., Gonçalves, A., Ferrão, P., Freitas, M., Leão, A., & DelArco Jr, A. (2007). *Water absorption studies of vegetable fibers reinforced polypropylene composite.* Paper presented at the Proceedings of 6 th International Symposium on Natural Polymers and Composite.

Machaka, M. M., Basha, H. S., & ElKordi, A. M. (2014). The effect of using fan palm natural fibers on the mechanical properties and durability of concrete. *International Journal of Materials Science and Engineering, 2*(2), 76-80.

Madhu, P., Sanjay, M., Senthamaraikannan, P., Pradeep, S., Siengchin, S., Jawaid, M., & Kathiresan, M. (2020). Effect of various chemical treatments of prosopis juliflora fibers as composite reinforcement: physicochemical, thermal, mechanical, and morphological properties. *Journal of Natural Fibers, 17*(6), 833-844.

Magzoub, R., Osman, Z., Tahir, P., Nasroon, T., & Kantner, W. (2015). Comparative evaluation of mechanical and physical properties of particleboard made from bagasse fibers and improved by using different methods. *Cell Chem Technol, 49*(5-6), 537-542.

Mahendran, A. R., Wuzella, G., Aust, N., Müller, U., & Kandelbauer, A. (2013). Processing and characterization of natural fiber reinforced composite using lignin phenolic binder. *Polymers and Polymer Composite, 21*(4), 199-206.

Mahmoud, S., Zayed, T., & Fahmy, M. (2019). Development of sustainability assessment tool for existing buildings. *Sustainable Cities and Society, 44*, 99-119.

Malawade, U. A., & Jadhav, M. (2020). Investigation of the acoustic performance of bagasse. *Journal of Materials Research and Technology, 9*(1), 882-889.

Malaysian Palm Oil Industry Performance (2008), Global Oils & Fats Business Magazine *6*(1 Jan-March).

Maldas, D., & Kokta, B. (1991). Studies on the preparation and properties of particle boards made from bagasse and PVC: II. Influence of the addition of coupling agents. *Bioresource Technology, 35*(3), 251-261.

Maleque, M. A., Afdzaluddin, A., & Iqbal, M. (2012). *Flexural and impact properties of kenaf-glass hybrid composite.* Paper presented at the Advanced Materials Research.

Mamtaz, H., Fouladi, M. H., Al-Atabi, M., & Narayana Namasivayam, S. (2016). Acoustic absorption of natural fiber composite. *Journal of Engineering, 2016*.

Manimaran, P., Senthamaraikannan, P., Sanjay, M., Marichelvam, M., & Jawaid, M. (2018). Study on characterization of Furcraea foetida new natural fiber as composite reinforcement for lightweight applications. *Carbohydrate Polymers, 181*, 650-658.

Manohar, K. (2012). Experimental investigation of building thermal insulation from agricultural by-products. *British Journal of Applied Science & Technology, 2*(3), 227.

Manohar, K., Ramlakhan, D., Kochhar, G., & Haldar, S. (2006). Biodegradable fibrous thermal insulation. *Journal of the Brazilian Society of Mechanical Sciences and Engineering, 28*(1), 45-47.

Manohar, K., Ramroopsingh, J., & Yarbrough, D. W. (2002). Use of sugarcane fiber as building insulation *Insulation Materials: Testing and Applications: 4 th Volume*: ASTM International.

Maruyama, S., Takagi, H., & Nakagaito, A. N. (2019). Influence Of Silane Treatment On Water Absorption And Mechanical Properties Of Pla/Short Bamboo Fiber-Reinforced Green Composite. *Wit Transactions on Engineering Sciences, 124*, 101-107.

Mateus, R., Neiva, S., Bragança, L., Mendonça, P., & Macieira, M. (2013). Sustainability assessment of an innovative lightweight building technology for partition walls–comparison with conventional technologies. *Building and environment, 67*, 147-159.

Mathew, A. P., Oksman, K., & Sain, M. (2005). Mechanical properties of biodegradable composite from poly lactic acid (PLA) and microcrystalline cellulose (MCC). *Journal of applied polymer science, 97*(5), 2014-2025.

Matykiewicz, D., Barczewski, M., Mysiukiewicz, O., & Skórczewska, K. (2021). Comparison of various chemical treatments efficiency in relation to the properties of flax, hemp fibers and cotton trichomes. *Journal of Natural Fibers, 18*(5), 735-751.

May-Pat, A., Valadez-González, A., & Herrera-Franco, P. J. (2013). Effect of fiber surface treatments on the essential work of fracture of HDPE-continuous henequen fiber-reinforced composite. *Polymer Testing, 32*(6), 1114-1122.

May, C. Y. (2012). Malaysia: economic transformation advances oil palm industry. *AOCS INFORM*, 1-8.

Melo, J. D. D., Carvalho, L. F. M., Medeiros, A. M., Souto, C. R., & Paskocimas, C. A. (2012). A biodegradable composite material based on polyhydroxybutyrate (PHB) and carnauba fibers. *Composite Part B: Engineering, 43*(7), 2827-2835.

Mitra, B. (2014). Environment friendly composite materials: biocomposite and green composite. *Defence Science Journal, 64*(3), 244.

Mohan, R., & Kishore. (1985). Jute-glass sandwich composite. *Journal of Reinforced plastics and composite, 4*(2), 186-194.

Mohanty, A. K., Misra, M. a., & Hinrichsen, G. (2000). Biofibers, biodegradable polymers and biocomposite: An overview. *Macromolecular materials and Engineering, 276*(1), 1-24.

Mohd, J., Rozli, Z., Nowshad, A., & Mohammad, H. F. (2010). Effect of different factors on the acoustic absorption of coir fiber. *Journal of Applied Sciences, 10*(22), 2887-2892.

Mohd, N. H., Alim, A., Aqila, A., Zahari, J. I., Yarmo, M. A., Ahmad, I., I., Abu Tahari, M.N., Kargarzadeh & Othaman, R. (2017). *Properties of aminosilane modified nanocrytalline cellulose (NCC) from oil palm empty fruit bunch (OPEFB) fibers.* Paper presented at the Materials Science Forum.

Mohomane, S. M., Motaung, T. E., & Revaprasadu, N. (2017). Thermal degradation kinetics of sugarcane bagasse and soft wood cellulose. *Materials, 10*(11), 1246.

Mokhena, T. C., Mochane, M. J., Motaung, T. E., Linganiso, L. Z., Thekisoe, O. M., & Songca, S. P. (2017). Sugarcane Bagasse and Cellulose Polymer Composite *Sugarcane-Technology and Research*: IntechOpen.

Moncada, L. G. G., Asdrubali, F., & Rotili, A. (2013). Influence of new fac tors on global energy prospects in the medium term: compar ison among the 2010, 2011 and 2012 editions of the IEA's World Energy Outlook reports. *Economics and Policy of Energy and the Environment*.

Moretti, E., Belloni, E., & Agosti, F. (2016). Innovative mineral fiber insulation panels for buildings: Thermal and acoustic characterization. *Applied energy, 169*, 421-432.

Morteza Mostashari, S., & Fallah Moafi, H. (2007). Thermogravimetric analysis of a cellulosic fabric incorporated with ammonium iron (II)-sulfate hexahydrate as a flame-retardant. *Journal of Industrial Textiles, 37*(1), 31-42.

Moszynski, P. (2011). WHO warns noise pollution is a growing hazard to health in Europe: British Medical Journal Publishing Group.

Motaung, T. E., & Mochane, M. J. (2017). Systematic review on recent studies on sugar cane bagasse and bagasse cellulose polymer composite. *Journal of Thermoplastic Composite Materials*, 0892705717738292.

Mothé, C., & de Miranda, I. (2009). Characterization of sugarcane and coconut fibers by thermal analysis and FTIR. *Journal of Thermal Analysis and Calorimetry, 97*(2), 661-665.

MS 1498:1997, SIRIM Standard, M. (1997). Standard for oil palm fiber, SIRIM Berhad, Malaysia. 1-3.

Muhammad, M., Sa'at, N., Naim, H., Isa, M. C., Yussof, N. H. N., & Yati, M. S. D. (2012). The effect of air gap thickness on sound absorption coefficient of polyurethane foam. *Def ST Tech Bull*, *5*(2), 176-187.

Mulinari, D. R., Cipriano, J. d. P., Capri, M. R., & Brandão, A. T. (2018). Influence of Surgarcane Bagasse Fibers with Modified Surface on Polypropylene Composite. *Journal of Natural Fibers*, *15*(2), 174-182.

Munoz, E., & García-Manrique, J. A. (2015). Water absorption behaviour and its effect on the mechanical properties of flax fiber reinforced bioepoxy composite. *International journal of polymer science*, *2015*.

Nagy, B., Nehme, S. G., & Szagri, D. (2015). Thermal properties and modeling of fiber reinforced concretes. *Energy Procedia*, *78*, 2742-2747.

Nasir, M. H. A., & Hassan, A. S. (2020). Thermal performance of double brick wall construction on the building envelope of high-rise hotel in Malaysia. *Journal of building Engineering, 31*, 101389.

Nechita, P., & Ionescu, Ș. M. (2017). Investigation on the thermal insulation properties of lightweight biocomposite based on lignocellulosic residues and natural polymers. *Journal of Thermoplastic Composite Materials*.

Nechita, P., & Ionescu, Ș. M. (2018). Investigation on the thermal insulation properties of lightweight biocomposite based on lignocellulosic residues and natural polymers. *Journal of Thermoplastic Composite Materials, 31*(11), 1497-1509.

Nelson, W. (2002). Compressed earth blocks. *Art of Natural Building*, 138-142.

Nemec, M., Igaz, R., Gergel, T., Danihelová, A., Ondrejka, V., Krišt'ák, L., Gejdoš, M & Kminiak, R. (2019). Acoustic and thermophysical properties of insulation materials based on wood wool. *Akustika*, *33*, 115-123.

Neves Monteiro, S., Salgado de Assis, F., Ferreira, C. L., Tonini Simonassi, N., Pondé Weber, R., Souza Oliveira, M., M., Colorado, H.A. & Camposo Pereira, A. (2018). Fique fabric: a promising reinforcement for polymer composite. *Polymers*, *10*(3), 246.

Ngo, W., Pang, M., Yong, L., & Tshai, K. (2014). Mechanical properties of natural fiber (kenaf, oil palm empty fruit bunch) reinforced polymer composite. *Advances in Environmental Biology*, 2742-2748.

Nor Azlina, R., Jawaid, M., Ahmad Safwan, I., Edi Syams, Z., & Shaikh Abdul Karim, Y. (2021). Evaluation of Thermal and Acoustic Properties of Oil Palm Empty Fruit Bunch/Sugarcane Bagasse Fibers Based Hybrid Composite for Wall Buildings Thermal Insulation. *Fibers and Polymers*, 1-9.

Nor Azlina, R., Jawaid, M., Edi Syams, Z., & Shaikh Abdul Karim, Y. (2019a). Modification of oil palm empty fruit bunch and sugarcane bagasse biomass as potential reinforcement for composite panel and thermal insulation materials. *Journal of Bionic Engineering, 16*(1), 175-188.

Nor Azlina, R., Jawaid, M., Edi Syams, Z., & Shaikh Abdul Karim, Y. (2019b). Tensile, physical and morphological properties of oil palm empty fruit bunch/sugarcane bagasse fiber reinforced phenolic hybrid composite. *Journal of Materials Research and Technology, 8*(4), 3466-3474.

Nor Azlina, R., Jawaid, M., Shaikh Abdul Karim, Y., Edi Syams, Z., & Alamery, S. (2021). Effect of surface treatment on mechanical, physical and morphological properties of oil palm/bagasse fiber reinforced phenolic hybrid composite for wall thermal insulation application. *Construction and Building Materials, 276*, 122239.

Nor Azlina, R., Naveen, J., & Jawaid, M. (2020). Potential of oil palm empty fruit bunch (OPEFB) and sugarcane bagasse fibers for thermal insulation application–A review. *Construction and Building Materials*, 121519.

Norsuraya, S., Fazlena, H., & Norhasyimi, R. (2016). Sugarcane bagasse as a renewable Source of silica to synthesize Santa Barbara Amorphous-15 (SBA-15). *Procedia Engineering, 148*, 839-846.

Nurazzi, N. M., Asyraf, M. R. M., Rayung, M., Norrrahim, M. N. F., Shazleen, S. S., Rani, M. S. A., & Abdan, K. (2021). Thermogravimetric analysis properties of cellulosic natural fiber polymer composite: a review on influence of chemical treatments. *Polymers, 13*(16), 2710.

Ofori, G., Briffett IV, C., Gang, G., & Ranasinghe, M. (2000). Impact of ISO 14000 on construction enterprises in Singapore. *Construction Management & Economics, 18*(8), 935-947.

Oldham, D. J., Egan, C. A., & Cookson, R. D. (2011). Sustainable acoustic absorbers from the biomass. *Applied Acoustics, 72*(6), 350-363.

Oliveira, P. R., Ribeiro Filho, S. L. M., Panzera, T. H., Christoforo, A. L., Durão, L. M. P., & Scarpa, F. (2020). Hybrid polymer composite made of sugarcane bagasse fibers and disposed rubber particles. *Polymers and Polymer Composite*, 0967391120943459.

Omoniyi, T. E. (2019). Potential of Oil Palm (Elaeisguineensis) Empty Fruit Bunch Fibers Cement Composite for Building Applications. *AgriEngineering, 1*(2), 153-163.

Onésippe, C., Passe-Coutrin, N., Toro, F., Delvasto, S., Bilba, K., & Arsène, M.-A. (2010). Sugar cane bagasse fibers reinforced cement composite: thermal considerations. *Composite Part A: Applied Science and Manufacturing, 41*(4), 549-556.

Ooi, H. S. (2012). Applying green technology in the palm oil industry.

Or, K. H., Putra, A., & Selamat, M. Z. (2017). Oil palm empty fruit bunch fibers as sustainable acoustic absorber. *Applied Acoustics, 119*, 9-16.

Osman, E., Vakhguelt, A., Sbarski, I., & Mutasher, S. (2011). *Water absorption behavior and its effect on the mechanical properties of kenaf natural fiber unsaturated polyester composite.* Paper presented at the Proceedings of the 18th International Conference on Composite Materials (ICCM'11).

Pacheco-Torgal, F., Cabeza, L. F., Labrincha, J., & De Magalhaes, A. G. (2014). *Eco-efficient construction and building materials: life cycle assessment (LCA), eco-labelling and case studies*: woodhead Publishing.

Paiva, J. M., & Frollini, E. (2002). Sugarcane bagasse reinforced phenolic and lignophenolic composite. *Journal of Applied Polymer Science, 83*(4), 880-888.

Pan, M., Zhang, S., & Zhou, D. (2010). Preparation and properties of wheat straw fiber-polypropylene composite. Part II. Investigation of surface treatments on the thermo-mechanical and rheological properties of the composite. *Journal of Composite Materials, 44*(9), 1061-1073.

Panyakaew, S., & Fotios, S. (2008). *321: agricultural waste materials as thermal insulation for dwellings in thailand: preliminary results.* Paper presented at the 25 Conference on Passive and Low Energy Architecture, Dublin.

Panyakaew, S., & Fotios, S. (2011). New thermal insulation boards made from coconut husk and bagasse. *Energy and Buildings, 43*(7), 1732-1739.

Panyasart, K., Chaiyut, N., Amornsakchai, T., & Santawitee, O. (2014). Effect of surface treatment on the properties of pineapple leaf fibers reinforced polyamide 6 composite. *Energy procedia, 56*, 406-413.

Papadopoulos, A. M. (2005). State of the art in thermal insulation materials and aims for future developments. *Energy and buildings, 37*(1), 77-86.

Pape, P. G., & Plueddeman, E. P. (1986). History of silane coupling agents in polymer composite. *History of Polymeric Composite*, 105-139.

Pape, P. G. (2017). Chapter 25—Adhesion Promoters: Silane Coupling Agents. *Plastics Design Library, Applied Plastics Engineering Handbook, 2nd ed.; Kutz, M., Ed*, 555-572.

Pásztory, Z., Horváth, T., Glass, S. V., & Zelinka, S. (2018). Experimental investigation of the influence of temperature on thermal conductivity of multilayer reflective thermal insulation. *Energy and Buildings, 174*, 26-30.

Pásztory, Z. (2021). An overview of factors influencing thermal conductivity of building insulation materials. *Journal of Building Engineering*, *44*, 102604.

Pereira, P. H. F., Voorwald, H. C. J., Cioffi, M. O. H., Mullinari, D. R., Da Luz, S. M., & Da Silva, M. L. C. P. (2011). Sugarcane bagasse pulping and bleaching: Thermal and chemical characterization. *BioResources*, *6*(3), 2471-2482.

Pickering, K. L., Efendy, M. A., & Le, T. M. (2016). A review of recent developments in natural fiber composite and their mechanical performance. *Composite Part A: Applied Science and Manufacturing*, *83*, 98-112.

Pizzi, A., & Ibeh, C. C. (2014). Phenol–formaldehydes. In *Handbook of thermoset plastics* (pp. 13-44). William Andrew Publishing.

Piggott, M., & Harris, B. (1981). Compression strength of hybrid fiber-reinforced plastics. *Journal of Materials Science, 16*(3), 687-693.

Pisello, A. (2015). Experimental analysis of cool traditional solar shading systems for residential buildings. *Energies, 8*(3), 2197-2210.

Poletto, M., Dettenborn, J., Pistor, V., Zeni, M., & Zattera, A. J. (2010). Materials produced from plant biomass: Part I: evaluation of thermal stability and pyrolysis of wood. *Materials Research*, *13*(3), 375-379.

Puglia, D., Biagiotti, J., & Kenny, J. (2005). A review on natural fiber-based composite—Part II: Application of natural reinforcements in composite materials for automotive industry. *Journal of Natural Fibers, 1*(3), 23-65.

Puglia, D., Monti, M., Santulli, C., Sarasini, F., De Rosa, I. M., & Kenny, J. M. (2013). Effect of alkali and silane treatments on mechanical and thermal behavior of Phormium tenax fibers. *Fibers and Polymers*, *14*(3), 423-427

Putra, A., Abdullah, Y., Efendy, H., Farid, W. M., Ayob, M. R., & Py, M. S. (2013). Utilizing sugarcane wasted fibers as a sustainable acoustic absorber. *Procedia Engineering*, *53*, 632-638.

Putra, A., Or, K. H., Selamat, M. Z., Nor, M. J. M., Hassan, M. H., & Prasetiyo, I. (2018). Sound absorption of extracted pineapple-leaf fibers. *Applied acoustics*, *136*, 9-15

Putra, A., Abdullah, Y., Efendy, H., Farid, W. M., Ayob, M. R., & Py, M. S. (2013). Utilizing sugarcane wasted fibers as a sustainable acoustic absorber. *Procedia Engineering, 53*, 632-638.

Pyun, J.-H., Shin, T.-B., Lee, J.-H., Ahn, K.-M., Kim, T.-H., & Cha, H.-S. (2016). Effects of hydrogen peroxide pretreatment and heat activation of silane on the shear bond strength of fiber-reinforced composite posts to resin cement. *The journal of advanced prosthodontics*, *8*(2), 94-100.

Rabelo, S., Fonseca, N. A., Andrade, R., Maciel Filho, R., & Costa, A. (2011). Ethanol production from enzymatic hydrolysis of sugarcane bagasse pretreated with lime and alkaline hydrogen peroxide. *Biomass and bioenergy, 35*(7), 2600-2607.

Rachini, A., Le Troedec, M., Peyratout, C., & Smith, A. (2009). Comparison of the thermal degradation of natural, alkali-treated and silane-treated hemp fibers under air and an inert atmosphere. *Journal of applied polymer science, 112*(1), 226-234.

Rainey, T. J., Doherty, W. O., Martinez, D., Brown, R. J., & Kelson, N. A. (2009). An experimental study of Australian sugarcane bagasse pulp permeability. *Appita Journal: Journal of the Technical Association of the Australian and New Zealand Pulp and Paper Industry, 62*(4), 296.

Rangappa, S. M., & Siengchin, S. (2018). Natural fibers as perspective materials. *King Mongkut's University of Technology North Bangkok International Journal of Applied Science and Technology, 11*(4).

Rashid, B., Leman, Z., Jawaid, M., Ghazali, M. J., & Ishak, M. R. (2016). The mechanical performance of sugar palm fibers (ijuk) reinforced phenolic composite. *International Journal of Precision Engineering and Manufacturing, 17*(8), 1001-1008.

Rayung, M., Ibrahim, N. A., Zainuddin, N., Saad, W. Z., Razak, N. I. A., & Chieng, B. W. (2014). The effect of fiber bleaching treatment on the properties of poly (lactic acid)/oil palm empty fruit bunch fiber composite. *International journal of molecular sciences, 15*(8), 14728-14742.

Razak, N. I. A., Ibrahim, N. A., Zainuddin, N., Rayung, M., & Saad, W. Z. (2014). The influence of chemical surface modification of kenaf fiber using hydrogen peroxide on the mechanical properties of biodegradable kenaf fiber/poly (lactic acid) composite. *Molecules, 19*(3), 2957-2968.

Razak Wahab, M. S. S., Ros Syazmini Mohd Ghani, Nasihah Mokhtar, Siti Marlia Mohd Don and Hashim W. Samsi. (2019). Properties of Composite Boards Properties from Elaeis guineensis Empty Fruit Bunch. *Borneo Journal of Sciences and Technology, Volume (1)*(Issue (1)), Pages 53-61.

Reddy, N., & Yang, Y. (2015). Fibers from Sugarcane Bagasse *Innovative Biofibers from Renewable Resources* (pp. 29-30): Springer.

Reis, J. M. L. (2006). Fracture and flexural characterization of natural fiber-reinforced polymer concrete. *Construction and Building Materials, 20*(9), 673-678.

Rihayat, T., Salim, S., Audina, N., Khan, N., Sami, M., Yunus, M., Salisah, Z., Alam, P.N. & Yusuf, I. (2018). Composite material making from empty fruit bunches of palm oil (EFB) and Ijuk (Arengapinnata) using plastic bottle waste as adhesives. Paper presented at the IOP Conference Series: *Materials Science and Engineering.*

Rilling, D., Siang, S. H., & Siang, S. H. (2006). *Thermal Behaviour Of Residential Buildings In South-East Asia Through Dynamic Simulation.* Paper presented at the 6th Asia Pacific And Construction Conference (APSEC), UTM, PWTC, Kuala Lumpur.

Rípoli, T. C. C., Molina Jr, W. F., & Rípoli, M. L. C. (2000). Energy potential of sugar cane biomass in Brazil. *Scientia Agricola, 57*(4), 677-681.

Rojo, E., Alonso, M. V., Oliet, M., Del Saz-Orozco, B., & Rodriguez, F. (2015). Effect of fiber loading on the properties of treated cellulose fiber-reinforced phenolic composite. *Composite Part B: Engineering, 68*, 185-192.

Roslan, R., Zakaria, S., Chia, C. H., Boehm, R., & Laborie, M.P. (2014). Physico-mechanical properties of resol phenolic adhesives derived from liquefaction of oil palm empty fruit bunch fibers. *Industrial Crops and Products, 62*, 119-124.

Rosli, N. S., Harun, S., Jahim, J. M., & Othaman, R. (2017). Chemical and physical characterization of oil palm empty fruit bunch. *Malaysian Journal of Analytical Sciences, 21*(1), 188-196.

Rowell, M., Han, J., & Rowell, J. (2001). Natural polymers and agrofibers composite fibers. *Journal of Plastic Composite, 31*, 21-23.

Rozli, S. R. B., & Azmir, N. A. (2020). The Study on Acoustic Properties of Sugarcane Bagasse as Sound Absorber. *Advanced Research in Natural Fibers*, *2*(1), 5-9.

Rozman, H., Peng, G., & Mohd. Ishak, Z. (1998). The effect of compounding techniques on the mechanical properties of oil palm empty fruit bunch–polypropylene composite. *Journal of Applied Polymer Science, 70*(13), 2647-2655.

Rozman, H., Saad, M., & Mohd Ishak, Z. (2003). Modification of oil palm empty fruit bunches with maleic anhydride: The effect on the tensile and dimensional stability properties of empty fruit bunch/polypropylene composite. *Journal of Applied Polymer Science, 87*(5), 827-835.

Rozman, H., Tay, G., Kumar, R., Abusamah, A., Ismail, H., & Ishak, Z. M. (2001). Polypropylene–oil palm empty fruit bunch–glass fiber hybrid composite: a preliminary study on the flexural and tensile properties. *European polymer journal, 37*(6), 1283-1291.

Saba, N., Paridah, M., & Jawaid, M. (2015). Mechanical properties of kenaf fiber reinforced polymer composite: A review. *Construction and Building materials, 76*, 87-96.

Sabri, M. M., Bakar, M. A., Masri, M. N., Mohamed, M., Noriman, N. Z., Dahham, O. S., & Umar, M. U. (2020, March). Effect of chemical treatment on mechanical and physical properties of non-woven kenaf fiber mat reinforced polypropylene biocomposite. In *AIP Conference Proceedings* (Vol. 2213, No. 1, p. 020262). AIP Publishing LLC.

Safwan, A., Jawaid, M., Sultan, M. T., & Hassan, A. (2018). Preliminary Study on Tensile and Impact Properties of Kenaf/Bamboo Fiber Reinforced Epoxy Composite. *Journal of Renewable Materials*.

Safwan,A I., Jawaid, M., & Naveen, J. (2019). Void content, tensile, vibration and acoustic properties of kenaf/bamboo fiber reinforced epoxy hybrid composite. *Materials, 12*(13), 2094.

Sahari, J., Sapuan, S., Zainudin, E., & Maleque, M. (2013). Mechanical and thermal properties of environmentally friendly composite derived from sugar palm tree. *Materials & Design, 49*, 285-289.

Saheb, D. N., & Jog, J. P. (1999). Natural fiber polymer composite: a review. *Advances in Polymer Technology: Journal of the Polymer Processing Institute*, *18*(4), 351-363.

Saini, G., Narula, A., Choudhary, V., & Bhardwaj, R. (2010). Effect of particle size and alkali treatment of sugarcane bagasse on thermal, mechanical, and morphological properties of pvc-bagasse composite. *Journal of Reinforced Plastics and Composite, 29*(5), 731-740.

Sair, S., Oushabi, A., Kammouni, A., Tanane, O., Abboud, Y., & El Bouari, A. (2018). Mechanical and thermal conductivity properties of hemp fiber reinforced polyurethane composite. *Case studies in construction materials, 8*, 203-212.

Sair, S., Oushabi, A., Kammouni, A., Tanane, O., Abboud, Y., Hassani, F. O., Laachachi, A., & El Bouari, A. (2017). Effect of surface modification on morphological, mechanical and thermal conductivity of hemp fiber: Characterization of the interface of hemp–Polyurethane composite. *Case studies in thermal engineering, 10*, 550-559.

Salam, M. (2006). Effect of hydrogen peroxide bleaching onto sulfonated jute fiber. *Journal of applied polymer science, 99*(6), 3603-3607.

Salama, Y., Chennaoui, M., El Amraoui, M., & Mountadar, M. (2007), A Review of Compost Produced from Biological Wastes: Sugarcane Industry Waste.

Samaei, S. E., Mahabadi, H. A., Mousavi, S. M., Khavanin, A., Faridan, M., & Taban, E. (2020). The influence of alkaline treatment on acoustical, morphological, tensile and thermal properties of Kenaf natural fibers. *Journal of Industrial Textiles*, 1528083720944240.

Samsudin, E. M., Ismail, L. H., Kadir, A. A., & Mokdar, S. S. S. (2016). Comparison On Acoustic Performance Between Dust And Coir Form Empty Fruit Bunches (Efb) As Sound Absorption Material. *Jurnal Teknologi*, *78*(5).

Sanal, I., & Verma, D. (2019). Construction Materials Reinforced with Natural Products (pp. 1-24): Springer: Basel, Switzerland.

Sanjay, M. R., & Siengchin, S. (2018). Natural fibers as perspective materials, KMUTNB: *International Journal Applied Science Technology*, 11, 233

Sanjay, M. R., & Siengchin, S. (2019). Lightweight natural fiber composite. *Journal of Applied Agricultural Science and Technology, 3*(2), 178-178.

Sant'Anna, C., & de Souza, W. (2012). Microscopy as a tool to follow deconstruction of lignocellulosic biomass. *Formatex Research Center, Espanha*, 639-645.

Sapuan, M. S. (2014). Tropical natural fiber composite. *Tropical Natural fibers and their properties*, 15.

Sassoni, E., Manzi, S., Motori, A., Montecchi, M., & Canti, M. (2014). Novel sustainable hemp-based composite for application in the building industry: Physical, thermal and mechanical characterization. *Energy and buildings, 77*, 219-226.

Sawpan, M. A., Pickering, K. L., & Fernyhough, A. (2011). Effect of fiber treatments on interfacial shear strength of hemp fiber reinforced polylactide and unsaturated polyester composite. *Composite Part A: Applied Science and Manufacturing, 42*(9), 1189-1196.

Schiavoni, S., Bianchi, F., & Asdrubali, F. (2016). Insulation materials for the building sector: A review and comparative analysis. *Renewable and sustainable energy reviews, 62*, 988-1011.

Schwanninger, M., Rodrigues, J., Pereira, H., & Hinterstoisser, B. (2004). Effects of short-time vibratory ball milling on the shape of FT-IR spectra of wood and cellulose. *Vibrational Spectroscopy, 36*(1), 23-40.

Seun I. Jesuloluwa and Ige B. (2018). Formation of Ceiling Boards by the Combination of Sugarcane Bagasse and Rice Husk. *Proceedings of ICGET*.

Sever, K., Sarikanat, M., Seki, Y., Erkan, G., & Erdoğan, Ü. H. (2010). The mechanical properties of γ-methacryloxypropyltrimethoxy silane-treated jute/polyester composite. *Journal of composite Materials, 44*(15), 1913-1924.

Shahroze, R. M., Ishak, M. R., Salit, M. S., Leman, Z., Chandrasekar, M., Munawar, N. S., & Asim, M. (2020). Sugar palm fiber/polyester nanocomposite: Influence of adding nanoclay fillers on thermal, dynamic mechanical, and physical properties. *Journal of Vinyl and Additive Technology, 26*(3), 236-243.

Shahzad, A. (2012). Hemp fiber and its composite–a review. *Journal of Composite Materials, 46*(8), 973-986.

Shibata, S., Cao, Y., & Fukumoto, I. (2005). Effect of bagasse fiber on the flexural properties of biodegradable composite. *Polymer Composite, 26*(5), 689-694.

Siakeng, R., Jawaid, M., Ariffin, H., & Sapuan, S. (2018). Thermal properties of coir and pineapple leaf fiber reinforced polylactic acid hybrid composite. Paper presented at the IOP Conference Series: *Materials Science and Engineering*.

Simona, P. L., Spiru, P., & Ion, I. V. (2017). Increasing the energy efficiency of buildings by thermal insulation. *Energy Procedia, 128*, 393-399.

Siva, V., Hoppe, T., & Jain, M. (2017). Green Buildings in Singapore; Analyzing a Frontrunner's Sectoral Innovation System. *Sustainability, 9*(6), 919.

Siyamak, S., Ibrahim, N. A., Abdolmohammadi, S., Yunus, W. M. Z. W., & Rahman, M. Z. A. (2012). Effect of fiber esterification on fundamental properties of oil palm empty fruit bunch fiber/poly (butylene adipate-co-terephthalate) biocomposite. *International journal of molecular sciences, 13*(2), 1327-1346.

Sreekala, M., George, J., Kumaran, M., & Thomas, S. (2002). The mechanical performance of hybrid phenol-formaldehyde-based composite reinforced with glass and oil palm fibers. *Composite science and technology, 62*(3), 339-353.

Sreekala, M., Kumaran, M., Geethakumariamma, M., & Thomas, S. (2004). Environmental effects in oil palm fiber reinforced phenol formaldehyde composite: Studies on thermal, biological, moisture and high energy radiation effects. *Advanced Composite Materials, 13*(3-4), 171-197.

Sreekala, M., Kumaran, M., Joseph, S., Jacob, M., & Thomas, S. (2000). Oil palm fiber reinforced phenol formaldehyde composite: influence of fiber surface modifications on the mechanical performance. *Applied Composite Materials, 7*(5-6), 295-329.

Sreekala, M., Kumaran, M., & Thomas, S. (1997). Oil palm fibers: Morphology, chemical composition, surface modification, and mechanical properties. *Journal of Applied Polymer Science, 66*(5), 821-835.

Sreekala, M., Kumaran, M., & Thomas, S. (2002). Water sorption in oil palm fiber reinforced phenol formaldehyde composite. *Composite Part A: Applied Science and Manufacturing, 33*(6), 763-777.

Subramonian, S., Ali, A., Amran, M., Sivakumar, L., Salleh, S., & Rajaizam, A. (2016). Effect of fiber loading on the mechanical properties of bagasse fiber–reinforced polypropylene composite. *Advances in Mechanical Engineering, 8*(8), 1687814016664258.

Sudiyani, Y., Styarini, D., Triwahyuni, E., Sembiring, K. C., Aristiawan, Y., Abimanyu, H., & Han, M. H. (2013). Utilization of biomass waste empty fruit bunch fiber of palm oil for bioethanol production using pilot–scale unit. *Energy Procedia, 32*, 31-38.

Sun, R., Sun, X., Fowler, P., & Tomkinson, J. (2002). Structural and physico-chemical characterization of lignins solubilized during alkaline peroxide treatment of barley straw. *European Polymer Journal, 38*(7), 1399-1407.

Sydow, Z., & Bieńczak, K. (2018). The overview on the use of natural fibers reinforced composite for food packaging. *Journal of Natural Fibers*.

Taiwo, E. M., Yahya, K., & Haron, Z. (2019). *Potential of using natural fiber for building acoustic absorber: A review.* Paper presented at the Journal of Physics: Conference Series.

Takagi, H., Nakagaito, A. N., & Liu, K. (2014). *Natural fiber composite with low thermal conductivity*. Paper presented at the 8th Australasian Congress on Applied Mechanics: ACAM 8.

Teja, M. S., Ramana, M., Sriramulu, D., & Rao, C. (2016). *Experimental investigation of mechanical and thermal properties of sisal fiber reinforced composite and effect of sic filler material.* Paper presented at the IOP Conference Series: Materials Science and Engineering.

Tewari, M., Singh, V., Gope, P., & Chaudhary, A. K. (2012). Evaluation of mechanical properties of bagasse-glass fiber reinforced composite. *J. Mater. Environ. Sci, 3*(1), 171-184.

Thakur, V. K., Singha, A. S., Kaur, I., Nagarajarao, R. P., & Liping, Y. (2010). Silane functionalization of Saccaharum cilliare fibers: Thermal, morphological, and physicochemical study. *International Journal of Polymer Analysis and Characterization, 15*(7), 397-414.

Thakur, V. K., & Thakur, M. K. (2014). Processing and characterization of natural cellulose fibers/thermoset polymer composite. *Carbohydrate polymers*, *109*, 102-117.

Then, Y. Y., Ibrahim, N. A., Zainuddin, N., Chieng, B. W., Ariffin, H., & Yunus, W. M. Z. W. (2015). Influence of alkaline-peroxide treatment of fiber on the mechanical properties of oil palm mesocarp fiber/poly (butylene succinate) biocomposite. *BioResources*, *10*(1), 1730-1746.

Thyavihalli Girijappa, Y. G., Mavinkere Rangappa, S., Parameswaranpillai, J., & Siengchin, S. (2019). Natural fibers as sustainable and renewable resource for development of eco-friendly composite: a comprehensive review. *Frontiers in Materials*, *6*, 226.

Tran, T. P. T., Bénézet, J.-C., & Bergeret, A. (2014). Rice and Einkorn wheat husks reinforced poly (lactic acid)(PLA) biocomposite: Effects of alkaline and silane surface treatments of husks. *Industrial Crops and Products, 58*, 111-124.

Trick, K. A., & Saliba, T. E. (1995). Mechanisms of the pyrolysis of phenolic resin in a carbon/phenolic composite. *Carbon, 33*(11), 1509-1515.

Uitterhaegen, E., Labonne, L., Ballas, S., Véronèse, T., & Evon, P. (2019). The coriander straw, an original agricultural by-product for the production of building insulation materials. *Academic Journal of Civil Engineering, 37*(2), 627-633.

Vargas Betancur, G. J., & Pereira Jr, N. (2010). Sugar cane bagasse as feedstock for second generation ethanol production: Part I: Diluted acid pretreatment optimization. *Electronic Journal of Biotechnology, 13*(3), 10-11.

Vazquez, A., Dominguez, V., & Kenny, J.M (1999). Bagasse fiber-polypropylene based composite. *Journal of Thermoplastic Composite Materials, 12*(6), 477-497.

Verma, D., Gope, P., Singh, I., & Jain, S. (2015). Composite from Bagasse fibers, Its characterization and applications *Agricultural biomass based potential materials* (pp. 91-119): Springer.

Vidyashri, V., Lewis, H., Narayanasamy, P., Mahesha, G., & Bhat, K. S. (2019). Preparation of chemically treated sugarcane bagasse fiber reinforced epoxy composite and their characterization. *Cogent Engineering, 6*(1), 1708644.

Vijay, R., Manoharan, S., Arjun, S., Vinod, A., & Singaravelu, D. L. (2020). Characterization of silane-treated and untreated natural fibers from stem of Leucas aspera. *Journal of Natural Fibers*, 1-17.

Vilay, V., Mariatti, M., Taib, R. M., & Todo, M. (2008). Effect of fiber surface treatment and fiber loading on the properties of bagasse fiber–reinforced unsaturated polyester composite. *Composite Science and Technology, 68*(3-4), 631-638.

Villain, G., Thiery, M., & Platret, G. (2007). Measurement methods of carbonation profiles in concrete: Thermogravimetry, chemical analysis and gammadensimetry. *Cement and Concrete Research*, *37*(8), 1182-1192.

Wambua, P., Ivens, J., & Verpoest, I. (2003). Natural fibers: can they replace glass in fiber reinforced plastics? *composite science and technology, 63*(9), 1259-1264.

Wang, H., Chiang, P.-C., Cai, Y., Li, C., Wang, X., Chen, T.-L., Wei S., & Huang, Q. (2018). Application of wall and insulation materials on green building: a review. *Sustainability, 10*(9), 3331.

Wang, X., & Petrů, M. (2019). Effect of hygrothermal aging and surface treatment on the dynamic mechanical behavior of flax fiber reinforced composite. *Materials, 12*(15), 2376.

WBCSD. (2007). Energy Efficiency In Buildings, Business Realities And Opportunities. *The World Business Council for Sustainable Development (WBCSD)*.

Wirawan, R., Sapuan, S., Yunus, R., & Abdan, K. (2012). Density and water absorption of sugarcane bagasse-filled poly (vinyl chloride) composite. *Polymers & Polymer Composite, 20*(7), 659.

Wong, K., Yousif, B., & Low, K. (2010). The effects of alkali treatment on the interfacial adhesion of bamboo fibers. *Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications, 224*(3), 139-148.

Xie, Y., Hill, C. A., Xiao, Z., Militz, H., & Mai, C. (2010). Silane coupling agents used for natural fiber/polymer composite: A review. *Composite Part A: Applied Science and Manufacturing, 41*(7), 806-819.

Xiong, W. (2018). Bagasse composite: A review of material preparation, attributes, and affecting factors. *Journal of Thermoplastic Composite Materials*, *31*(8), 1112-1146.

Xu, J., Sugawara, R., Widyorini, R., Han, G., & Kawai, S. (2004). Manufacture and properties of low-density binderless particleboard from kenaf core. *Journal of Wood Science*, *50*(1), 62-67.

Yang, H.-S., Kim, D.J., & Kim, H.J. (2003). Rice straw–wood particle composite for sound absorbing wooden construction materials. *Bioresource technology*, *86*(2), 117-121.

Yang, H.-S., Kim, H.J., Son, J., Park, H.J., Lee, B.J., & Hwang, T.S. (2004). Rice-husk flour filled polypropylene composite; mechanical and morphological study. *Composite structures*, *63*(3-4), 305-312.

Yang, W., & Li, Y. (2012). Sound absorption performance of natural fibers and their composite. *Science China Technological Sciences*, *55*(8), 2278-2283.

Yarbrough, D. W., Wilkes, K. E., Olivier, P. A., Graves, R. S., & Vohra, A. (2005). Apparent thermal conductivity data and related information for rice hulls and crushed pecan shells. *Thermal Conductivity*, *27*, 222-230.

Yuhazri, Y. M., Sihombing, H., Jeefferie, A., Mujahid, A. A., Balamurugan, A., Norazman, M., & Shohaimi, A. (2011). Optimization of coconut fibers toward heat insulator applications. *Global Engineers & Technologists Review*, *1*(1), 35-40.

Yunus, R., Salleh, S. F., Abdullah, N., & Biak, D. R. A. (2010). Effect of ultrasonic pre-treatment on low temperature acid hydrolysis of oil palm empty fruit bunch. *Bioresource technology*, *101*(24), 9792-9796.

Yusoff, M. Z. M., Salit, M. S., Ismail, N., & Wirawan, R. (2010). Mechanical properties of short random oil palm fiber reinforced epoxy composite. *Sains Malaysiana*, *39*(1), 87-92.

Zaaba, N. F., Jaafar, M., & Ismail, H. (2017). The effect of alkaline peroxide pre-treatment on properties of peanut shell powder filled recycled polypropylene composite. *Journal of Engineering Science*, *13*, 75.

Zafeiropoulos, N. E. (2011). *Interface engineering of natural fiber composite for maximum performance*: Elsevier.

Zagho, M. M., Hussein, E. A., & Elzatahry, A. A. (2018). Recent overviews in functional polymer composite for biomedical applications. *Polymers*, *10*(7), 739.

Zaid, S. M., Myeda, N. E., Mahyuddin, N., & Sulaiman, R. (2015). Malaysia's rising GHG emissions and carbon 'lock-in'risk: A review of Malaysian building sector legislation and policy. *Journal of Surveying, Construction and Property*, *6*(1), 1-13.

Zainal, M., Santiagoo, R., Ayob, A., Ghani, A. A., Mustafa, W. A., & Othman, N. S. (2020). Thermal and mechanical properties of chemical modification on sugarcane bagasse mixed with polypropylene and recycle acrylonitrile butadiene rubber composite. *Journal of Thermoplastic Composite Materials, 33*(11), 1533-1554.

Zhang, Y., Wang, J., Hu, F., & Wang, Y. (2017). Comparison of evaluation standards for green building in China, Britain, United States. *Renewable and sustainable energy reviews, 68*, 262-271.

Zhou, H., Li, B., & Huang, G. (2006). Sound absorption characteristics of polymer microparticles. *Journal of Applied Polymer Science, 101*(4), 2675-2679.

Zhou, H., Sun, F., Li, H., Zhang, W., Cheng, H., Chen, L., Yu, Z., Chen, F. & Wang, G. (2019). Development and Application of Modular Bamboo-composite Wall Construction. *BioResources, 14*(3), 7169-7181.

Zhou, X.-y., Zheng, F., Li, H.-g., & Lu, C.-l. (2010). An environment-friendly thermal insulation material from cotton stalk fibers. *Energy and Buildings, 42*(7), 1070-1074.

Zulkifli, R., Nor, M. J. M., Ismail, A. R., Nuawi, M. Z., Abdullah, S., Tahir, M. F. M., & Ab Rahman, M. N. (2009). Comparison of acoustic properties between coir fiber and oil palm fiber. *European Journal of Scientific Research, 33*(1), 144-152.

Zulkifli, R., Nor, M. M., Ismail, A., Nuawi, M., & Tahir, M. M. (2009). Effect of perforated size and air gap thickness on acoustic properties of coir fiber sound absorption panels. *European Journal of Scientific Research, 28*(2), 242-252