DEVELOPMENT AND CHARACTERIZATION OF RECYCLED CARBON-KENAF FILLED CARDANOL HYBRID COMPOSITES

ZAHRA DASHTIZADEH

IPTPH 2018 11

DEVELOPMENT AND CHARACTERIZATION OF RECYCLED CARBON-KENAF FILLED CARDANOL HYBRID COMPOSITES

By

ZAHRA DASHTIZADEH

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

May 2018

DEDICATION

This thesis is dedicated to:

My beloved parents for their extreme love, support, sacrifices, encouragement, inspirations, compassion and moral support throughout my life,

My respected parents-in-law for their kind support and encouragement,

My beloved husband for his non-stop love, caring and support,

My brothers for their reliable love

&

My lovely son for being such an understanding kid. He is my motivation for being the better version of myself.

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

DEVELOPMENT AND CHARACTERIZATION OF RECYCLED CARBON-KENAF FILLED CARDANOL HYBRID COMPOSITES

By

ZAHRA DASHTIZADEH

May 2018

Chairman: Assoc. Prof. Khalina Abdan, PhD
Faculty: Institute of Tropical Forestry and Forest Products

Kenaf fibers have shown a great potential to be a replacement for synthetic fibers due to their high specific strength, light weight, low cost and renewable source. However, like all other natural fibers, the mechanical properties of kenaf fiber are highly affected by its hydrophilic nature. Researchers suggest chemical treatment for fibers to improve its strength and compatibility with a variety of resins. In this research, the results indicate that alkaline and silane treatment with specific concentration increase single fiber tensile strength. The increment is higher for alkaline treatment compared to silane treatment. However, tensile strength of the composites made of treated kenaf fiber and cardanol (bio-phenolic derived from cashew nut shell liquid, CNSL) composite showed small improvement as compared to untreated kenaf fiber and cardanol composites.

Different fiber volume fractions were fabricated, 0%w Kenaf ,30%w Kenaf, 40%w Kenaf, 50%w Kenaf and 60%w Kenaf. Then the mechanical, thermal, physical, chemical and flammability properties of the specimens were studied. The Results showed that composite with 50%w Kenaf shows the highest tensile and flexural strength, while impact strength increased up to 60%w kenaf.

For further improvement of the mechanical properties, recycled carbon was used to fabricate the hybrid composites. Hybridization with recycled carbon enhanced the mechanical properties of cardanol/ kenaf composites. Also, hybridization of treated kenaf fibers with carbon fibers demonstrated higher mechanical properties.

In addition, thermal characterizations of the specimens indicate that cardanol improved the thermal stability of kenaf also hybridization with recycled carbon further improves

the thermal stability of the specimens. Flammability UL 90HB test determines the flame retardancy property of all specimens.

It was observed that the peak of tan δ for cardanol was higher than all other specimens which also agreed with the previous results that showed cardanol had a lower damping property and was more brittle than the kenaf/cardanol composites, the shift of tan δ and reduction of the absolute value indicate the interaction between kenaf and cardanol which enhanced the mechanical properties of the kenaf/cardanol composites. It was also observed that the specimen with higher fiber volume fraction showed the lower tan δ and higher damping property.

Abstrak tesis yang dibentangkan kepada Senat Universiti Putra Malaysia sebegai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBANGUNAN DAN PENCIRIAN KARBON-KENAF DIKENALI KANOAN KOMPOSIT HYBRID CARDANOL

Oleh

ZAHRA DASHTIZADEH

Mei 2018

Pengerusi : Prof.Madya Khalina Abdan, PhD
Fakulti: Institut Perhuntanan Tropika dan Produk Hutan

Gentian Kenaf telah menunjukkan potensi yang besar untuk menjadi pengganti gentian sintetik kerana kekuatan khusus mereka yang tinggi, ringan, kos rendah dan sumber yang boleh diperbaharui. Walau bagaimanapun, seperti semua gentian semulajadi lain, sifat mekanik gentian kenaf sangat terjejas oleh sifat hidrofiliknya. Penyelidik mencadangkan rawatan kimia kepada gentian untuk meningkatkan kekuatan dan keserasiannya dengan pelbagai resin. Dalam kajian ini, hasil menunjukkan bahawa rawatan alkali dan silane dengan kepekatan tertentu meningkatkan kekuatan tegangan gentian tunggal. Peningkatan ini adalah lebih tinggi untuk rawatan alkali berbanding dengan rawatan silane. Walaubagaimanapun, kekuatan tegangan komposit yang diperbuat daripada gentian kenaf dan kardanol yang dirawat (bio-fenolik yang diperolehi daripada cecair cashew kacang cecair, CNSL) menunjukkan peningkatan kecil berbanding dengan gentian kenaf yang tidak dirawat dan komposit kardanol.

Pecahan jumlah gentian yang berbeza dibuat, 0% w Kenaf, 30% w Kenaf, 40% w Kenaf, 50% w Kenaf dan 60% w Kenaf. Kemudian sifat-sifat mekanik, haba, fizikal, kimia dan mudah terbakar dari spesimen telah dipelajari. Keputusan menunjukkan bahawa komposit dengan 50% w Kenaf menunjukkan kekuatan tegangan dan lenturan tertinggi, manakala kekuatan impak meningkat sehingga 60% w kenaf.

Untuk penambahbaikan lagi sifat-sifat mekanik, karbon yang dikitar semula digunakan untuk mengarang komposit hibrid. Hibridisasi dengan karbon kitar semula meningkatkan sifat mekanik kardanol / kenaf komposit. Selain itu, hibridisasi gentian kenaf yang dirawat dengan gentian karbon menunjukkan sifat mekanikal yang lebih tinggi.

Di samping itu, ciri-ciri haba spesimen menunjukkan bahawa kardanol meningkatkan kestabilan haba kenaf begitu juga hibridisasi dengan karbon kitar semula seterusnya meningkatkan kestabilan terma spesimen. Ujian UL 90HB mudah terbakar menentukan sifat kelambatan api semua specimen.

Telah diperhatikan bahawa puncak tan δ untuk kardanol adalah lebih tinggi daripada semua spesimen lain yang juga bersetuju dengan keputusan sebelumnya yang menunjukkan bahawa kardanol mempunyai sifat redaman yang lebih rendah dan lebih rapuh daripada kenaf / kardanol komposit, perubahan tan δ dan pengurangan nilai mutlak menunjukkan interaksi antara kenaf dan kardanol yang meningkatkan sifat mekanik komposit kenaf / kardanol. Ia juga diperhatikan bahawa spesimen dengan pecahan isipadu gentian yang lebih tinggi menunjukkan tan δ yang lebih rendah dan sifat redaman yang lebih tinggi.

ACKNOWLEDEGEMENT

I thank Allah the most merciful, for the health, strength, mercy and his blessing given to me in completing my PhD thesis. I would like to gratefully express my appreciation to Institute of Tropical Forestry and Forest Products (INTROP), to pursue my PhD study. I wish to express my profound gratitude, indebtedness and deep appreciation to my main supervisor Assoc. Prof. Dr. Khalina Abdan for her extreme support, care and guidance throughout the completion of this research study. I am also highly thankful to the members of the supervisory committee, Dr. Mohammad Jawaid, Dr. Mohammad Ridzwan Ishak and Dr. Francisco Cardona for their valuable motivation and assistance in this research.

I am highly thankful to the Special Graduate Research Fellowship (SGRF) through E-Science Grant (MOSTI) for supporting my PhD work.

I sincerely owe a great appreciation and gratitude to my beloved father (Mr. Nader Dashtizadeh) and mother (Mrs. Shahin Shahraki) for their enormous love. Upright upbringing and honest supplications towards my duty from childhood till now. Besides, I am extremely grateful to my beloved father-in-law (Mr. Gholamreza Behmanesh) for his generosity, kindness and support of my education. Also I appreciate love and support received from my beloved mother-in-law (Mrs. Nastaran Nikmanesh). I wish to express my gratitude, appreciation and love to my husband (Mr. Mohammad Behmanesh) for his encouragement and endless emotional support during moments of prosperity and adversity. I am also highly thankful to my brothers for their love and care.

Last but not least, I wish to convey acknowledge to my all friends in Malaysia and Iran for their precious encouragement given throughout the entire PhD journey.

JazakAllahuKhairun!

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

Khalina Abdan, PhD
Associate Professor
Faculty of Engineering
Chairman, Universiti Putra Malaysia

Mohammad Ridzwan Ishak, PhD
Faculty of Engineering
Member, Universiti Putra Malaysia

Mohammad Jawaid, PhD
Fellow Researcher
Institute of Tropical Forestry and Forest Products
Member, Universiti Putra Malaysia

ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- This thesis is my original work;
- Quotations, illustrations and citations have been fully referenced;
- This thesis has not been submitted previously or currently for any other degree at any other institutions;
- Intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- Written permissions must be obtained from supervisor and the office of deputy vice-chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modulus, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modulus or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2010;
- There is no plagiarism or data falsification/ fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) rules 2003 (Revision 2012-2013) and the Univerisiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: Date:

Name and Matric No. : Zahra Dashtizadeh (GS37600)

Declaration by Members of Supervisory Committee

This is to confirm that:

- The research conducted and writing of this thesis was under our supervision;
- Supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature:
Name of Chairman of Supervisory Committee:
Assoc. Prof. Dr. Khalina Abdan

Signature:
Name of Member of Supervisory Committee:
Dr. Mohammad Ridzwan Bin Ishak

Signature:
Name of Member of Supervisory Committee:
Dr. Mohammad Jawaid

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AFM	Atomic force microscopy
ASTM	American society for testing and materials
C	Carbon
CL	Cardanol
CNSL	Cashew nut shell liquid
CNSO	Cashew nut shell oil
CM	Compression molding
cm	centimeter
CTBN	Carboxyl-terminated butadiene acrylonitrile
DGEBA	Diglycidyl ether bisphenol A
DMA	Dynamic mechanical analysis
DSC	Differential scanning calorimetry
ENR	Epoxidized natural rubber
g	Gram
GFRP	Glass fiber reinforced polymer
HEXA, HMTA	Hexamethylenetetramine (Hexamine)
INTROP	Institute of tropical forestry and forest products
KSBF	Kenaf short bast fiber
kg	kilogram
KS	Kenaf stem
MALDI	Matrix assisted laser desorption ionization
MJ	Mega Joule
mm	Millimeter
MPa	Mega Pascal
NaOH	Sodium hydroxide
PLA	Poly lactic acid
PMMA	Polymethyl methacrylate
PP	Polypropylene
PVC	Poly (vinyl chloride)
RCSF	Recycled carbon short fiber
RTM	Resin transfer molding
RW	Rubberwood
SEC	Size exclusion chromatography
sec	Second
SEM	Scanning electron microscopy
TGA	Thermogravimetric analysis
TK	Treated Kenaf fiber
TPU	Thermoplastic polyurethane
USP	Unsaturated polyester
UTK	Untreated Kenaf fiber

CHAPTER 1

INTRODUCTION

1.1 Introduction

Environmental issues such as sustainability, renewability, recyclability have risen the attention of researchers and industries to the materials with degradability and great mechanical, thermal and physical performance with low price (Markarian,2008), therefore, natural fibers have been introduced to material science since the artificial fibers have serious disadvantage on the human body and environment.

Substituting synthetic fibers with natural fibers or combining natural fibers with synthetics fibers (Mohanty et al.,2000 a&b) has been a motivation for material scientist to develop natural fiber composites that would enhance the life style of people globally with renewable and sustainable products. From economic aspect, due to increment of energy cost, the final cost of products with good properties is increasing (Abdul Khalil et al.,2011a) demanding the need of high performance materials with low cost.

Natural fibers have shown great advantages over synthetics fibers, such as low cost, light weight, abundant, easy processing and having market appeal (Karimi et al.,2014). Besides, the specific modulus, cost per weight (Nishino et al.,2003), high toughness, low density, low energy requirement for fabrication, CO_2 absorption (Paridah et al.,2011; Mohanty et al.,2000b) are other benefits of natural fibers over synthetic fibers.

However, with all great properties of natural fibers, the hydrophilic nature of the natural fibers decreases the mechanical properties significantly. Natural fibers are used as reinforcement in the resin that is called the matrix (Mohanty et al.,2000a &b). Therefore, the compatibility of the natural fibers and the polymer matrix significantly influences on the stress transfer from matrix to the fibers.

The hydrophobicity of most of the polymers and hydrophilicity of the natural fibers decreases the compatibility of the natural fiber and the polymer matrix. therefore, the poor adhesion between the fibers and resin makes it fail the required mechanical properties in most cases. Some researchers found chemical treatment is useful to overcome these drawbacks and improve or maintain the mechanical properties of the natural fiber composites (Faruk et al.,2012).

Silane treating cellulose fibers with phenolic as the matrix improved the fiber/matrix bonding and also its tensile strength (Rojo et al.,2015), treatment of jute fiber with alkaline and silane improved its interfacial strength between jute fiber and epoxy resin as the matrix (Doan et al.,2012).

In addition, the increment of reinforcement increases the mechanical properties (Ramesh,2016). There is an optimum balance between the amount of the fibers and the resin to achieve reasonably high mechanical and thermal properties. Sugar palm fiber reinforced phenolic composite showed its optimum mechanical properties with 30%vol of fiber in the matrix (Rashid et al.,2016).

In order to increase the reliability of the biocomposites in mechanical properties, the hybrid biocomposites have been introduced. For hybrid biocomposites, compatibility is significant because hybrid biocomposites are made up of two or more fibers in one or more resins. This composition is to increase the mechanical and thermal or other desired properties. Selection between different fibers or polymers from natural or synthetics sources and the amount of the fibers or polymers to be used in the hybrid composites depends on the property that is to be enhanced.

Besides, the mechanical properties of the biocomposites can be improved significantly with hybridization, since it can improve the toughness, for example, by hybridizing natural fibers with glass or carbon fibers that are known for their high toughness (Sanjay and Yogesha,2017). Hybridization of banana fiber with sisal reinforced epoxy composite increased the mechanical properties of the hybrid composite and showed a reduction on water absorption property (Venkateshwaran et al.,2011). A very good tensile and impact strength was reported by Yahaya et al., (2016a) for kenaf/ aramid/epoxy hybrid composites.

Another benefit of hybridization is cost reduction, for instance, to mix costly materials with cheaper materials. Plus, using the natural fibers in hybridization makes the final product lightweight that would decrease the fuel consumption (Alves et al.,2010) for automobile and aerospace industries. Therefore, it is more economical to use natural hybrid composites since decreased fuel consumption results in significant cost reduction. In summary, the hybridization can balance the cost and performance of the biocomposites.

In this research, a hybrid product is investigated with two types of fibers and one resin or matrix. The fibers are kenaf short bast fiber (KSBF) and recycled carbon short fiber (RCSF) while the resin is cardanol (CL) that is a phenolic-based bioresin extracted from cashew nut shell liquid (CNSL). Cardanol is a waste product in the cashew nut shell industry which is abundant in tropical region such as India with reasonable cheap price. This resin is a thermoset resin and is also known for its high-fire retardancy property that is a requirement for many industrial applications. However, the mechanical properties of cardanol based resin have been reported to be poor and the addition of reinforcement could improve the mechanical properties of cardanol based resin significantly (Maffezzoli et al.,2004).

Cardanol that is a novolac phenolic thermoset resin requires a curing agent for its molecular cross-linking. The curing agent is usually hexamethylenetetramine (HEXA) that is also called hexamine (Appendix 2). Phenolic resins are classified into two groups;

resole and novolac. Resole is a one-stage curing resin and does not need the cross-linking agent, while novolac is a two-stage curing resin that requires hexamine for curing. Usually, hexamine that is required for novolac resin is between 10% to 18% (Sathiyalekshmi,1993) of weight percentage of the novolac resin. Since the cardanol is a natural resin, it is assumed to be compatible with the kenaf fiber as compared to other synthetic polymers.

Kenaf is a tropical product with a Persian name that is a member of the Hibiscus cannabinus family. This non-wood plant can grow 4 to 6m per year (Bourguignon et al.,2016). The fibers derived from kenaf plant can be categorized into two groups; core fiber that is the core of the plant and is short and porous which makes it applicable for thermal insulant and absorbent material application. The bast fiber that is from the outer layers that is long fiber for different applications such as textile, paper pulp and as reinforcement in biocomposites (Bourguignon et al.,2016). Kenaf bast fiber is used more in industrial scale due to its higher mechanical properties compared to kenaf core fibers (Tye et al.,2016).

However, the mechanical properties of the natural fibers are still lower than the synthetics fibers since composites made of natural fibers cannot bear high loadings and the maximum loading applicable for natural fiber composites is only 20-30% from its yield strength (Salleh et al.,2014), therefore, recycled carbon fibers have been considered as the hybrid material for their high mechanical properties (Kwon et al.,2017).

Using recycled carbon fibers has a positive impact on the economy and the environment (Meng et al.,2017), because the new carbon fiber is expensive, and after finishing its life cycle, this expensive material is abandoned in landfills. Recycling the carbon fibers is a suitable method in order to reduce the trash in landfills as well as benefiting from its high mechanical properties. Since the carbon fibers have a wide range of modulus from 207GPa to 1035GPa (Flynn et al.,2016), they are used in many high-efficiency applications but mainly aerospace industry. That is another reason for using carbon as the hybrid material in this research because the potential application of this hybrid composite is in the aerospace industry.

The aim of this research was to develop and study a hybrid composite with reasonably high thermal, mechanical and physical performance which is made of environmental friendly biodegradable materials.

1.2 Problem statement

The high end industries, which use high-quality materials such as phenolic which is a phenol content material and is hazardous and pollutant with low degradability (Nady et al.,2017). Therefore, there is a huge need to substitute phenolic compound materials with biodegradable, non-toxic materials to fulfill the environmental and sustainability issues.

Currently, carbon and glass fibers are mostly the different state of the art industry which are non-biodegradable and heavy as compared to natural fibers. The heavy weight of glass or carbon fiber composites increase the fuel consumption (Jabbar et al.,2016). Besides the synthetics fibers are harmful to human health as well as create economic and environmental issues (Yahaya et al.,2015). Nevertheless, recycling the valuable carbon fiber has gained a great attention around the world, because of environmental issues, shortage of landfills and low regulation for waste products (Job,2010; Pickering,2006). Besides, the production of virgin carbon fiber is much more energy consuming than the producing steel, from 286MJ/kg for carbon fiber to 33MJ/kg for steel (Suzuki and Takahashi,2005).

In addition, replacing glass and carbon fibers with natural fibers requires a critical study. Natural fibers with all the benefits of being economical resources, high strength to weight ratio (Mahjoub et al.,2014b), and eco-friendly have some significant drawbacks. For instance, they hydrophilic and tend to absorb moisture that also causes a reduction in mechanical properties (Faruk et al.,2012). In addition, their quality is very much depended on the climate and soil of their farm (Flynn et al.,2016).

Due to increment in price of petrol/ chemical based resin and also environmental issues, natural resins have been studied lately. Cardanol which is a bio-phenolic resin derived from cashew nut shell liquid, is abundant in tropical environments such as in India and benefits from cheap price (Maffezzoli et al.,2004) however, very few studies have been performed on cardanol as a matrix for composites, as well as characterizing its curing parameters such as curing temperature and time.

Cardanol, having biodegradability, high thermal stability and fire retardancy properties is an attractive bioresins for composite structures. Up to date, cardanol has been used mostly to produce different types of thermoset polymer resins, in brake components (Maffezzoli et al.,2004) and in surface coating (S.Riya and S.Deepak ,2015) yet, a full investigation on curing temperature and time, mechanical and thermal properties is required to produce a source of matrix in composite manufacturing field.

In this study, cardanol is aimed to introduce as an interior cabin component which is 100% biodegradable, safe for human health and significantly cheap. This product shows reasonably good thermal, and fire retardancy properties. Considering the benefits of cardanol it is proposed to be used as the matrix and the reinforcement are kenaf bast fiber and recycled carbon fiber to produce a biodegradable composite with high fire retardancy and thermal stability properties.

The hypothesis of this study is that by hybridizing kenaf bast fiber and recycled carbon fiber the mechanical properties of the cardanol would be reasonably enhanced, besides because of high fire retardancy characterization of cardanol the hybrid biocomposite would demonstrate reasonably high thermal stability and flame retardancy performance.

1.3 Objectives

The objectives of this study are

1. To optimize chemical treatment solutions and determine interfacial adhesion and strength of kenaf single fiber
2. To investigate thermal, FTIR and morphological properties of cashew nut based cardanol
3. To characterize mechanical, morphological and physical properties of kenaf/cardanol biocomposites and recycled carbon/kenaf/cardanol hybrid biocomposites
4. To characterize the thermal and flammability properties of kenaf/cardanol biocomposites and recycled carbon/kenaf/cardanol hybrid biocomposites

1.4 Scope and limitations

This study was focused on the development of the hybrid biocomposite of kenaf short bast fiber with recycled carbon fiber reinforced with cardanol. Curing parameters of the cardanol are very important aspects that should be determined such as the temperature for curing and post curing which up to the author's knowledge no studies were available for this type of cardanol (the powder form).

The tensile, flexural, impact and water absorption of the hybrid composites were evaluated as well as thermal tests such as thermal gravimetric analyzer (TGA), differential scanning calorimetry (DSC), and dynamic mechanical analysis (DMA) to determine the mechanical and thermal properties of the specimens.

One of the limitations of this study was low mechanical properties of the cardanol as the matrix therefore, the scope was to improve the mechanical properties of the cardanol by reinforcement of kenaf and recycled carbon fiber as the hybridization material. Besides, maintaining the good fire retardancy and thermal stability of cardanol was of the author's considerations. However, since the density of carbon fiber is higher than that of kenaf and cardanol, therefore, the fabrication method with open mold was a limitation of this study, which could not be avoided.

Several researches have studied the mechanical and or thermal properties of different natural fiber hybridization or natural fiber with glass fiber hybridization, however, up to date, recycled carbon fiber has not been hybridized with kenaf fiber.

This hybridization could significantly encourage the industrial applications. In addition, cardanol has not been used as a matrix for kenaf fiber previously. The hybrid of kenaf/recycled carbon fiber reinforced cardanol could demonstrate high performance in mechanical and thermal properties as well as fire retardancy characterizations which would be an opening field in many industrial applications such as aerospace, automotive and building structures.

1.5 Thesis layout

There are five chapters in this thesis as described below:

1. Chapter One gives a brief introduction on the background of the study and need for this research. Objectives and the scope of the thesis are also expressed in chapter one.
2. Chapter Two elaborates the literature review the previous studies of the hybrid natural composites. The benefits and drawbacks of different hybrid natural composites are also discussed.
3. Chapter Three explains the methodology and describes in detail all the steps performed to complete this research by giving the figure for all the tests and specimens to provide the understanding of the methodology of this research.
4. Chapter Four clarifies the results and discusses the results of the mechanical and thermal tests. The results are supported and discussed with different graphs, tables and figures to give better knowledge of the specimens characteristics.
5. Chapter Five is the conclusion of the thesis which also includes a recommendation for further study. Finally, the thesis is closed with the bibliography of the author, references of the literature used in this thesis and the appendix containing the data sheet for the materials of the hybrid composites.

REFERENCES

Abdul Khalil H. P. S., Fizree H. M., Jawaid M., and Alattas Omar S., 2011a. preparation and characterization of nanostructured materials from oil palm ash: a bio agricultural waste from oil palm mill. *BioResources*, 6(4): 4537-4546

Abdul Khalil H. P. S., Jawaid M., Abu Bakar A.,2011b. Woven hybrid composites: Water absorption and thickness swelling behaviours. *BioResources*, 6(2): 1043-1052

Abdullah C. K., Jawaid M., Abdul Khalil H. P. S., Zaidon A., Hadiyaned A.,2012. Oil palm trunk polymer composite: Morphology, water absorption, and thickness swelling behaviours. *BioResources*, 7(3):2948-2959

Aji I.S., Zainudin E.S., Abdan K., Sapuan S.M., Khairul M.D., 2012. Mechanical properties and water absorption behavior of hybridized kenaf/pineapple leaf fiber reinforced high density polyethylene composite. *Journal of Composite Materials*, 47:979-990

Akil H.M., Omar M.F., Mazuki A.A.M., Safiee S., Ishak Z.A.M., Abu Bakar A., 2011. Kenaf fiber reinforced composites: A review, *Materials & Design*, 32 (8): 4107-4121,

Akil Hazizan Md., De Rosa Igor M., Santulli Carlo, Sarasini Fabrizio. 2010. Flexural behaviour of pultruded jute/glass and kenaf/glass hybrid composites monitored using acoustic emission. *Materials Science and Engineering*: A, 527(12): 2942-2950

Alavudeen A., Rajini N., Karthikeyan S., Thiruchitrambalam M., Venkateshwaren N.,2015. Mechanical properties of banana/kenaf fiber-reinforced hybrid polyester composites: Effect of woven fabric and random orientation. *Materials & Design (1980-2015)*, 66: 246-257

AL-Oqla Faris M., Sapuan S.M.,2014. Natural fiber reinforced polymer composites in industrial applications: feasibility of date palm fibers for sustainable automotive industry. *Journal of Cleaner Production*, 66: 347-354

Alves C., Ferrão P.M.C., Silva A.J., Reis L.G., Freitas M., Rodrigues L.B., Alves D.E.,2010. Ecodesign of automotive components making use of natural jute fiber composites. *Journal of Cleaner Production*, 18(4): 313-327

Ambrožič Rok, Šebenik Urška, Krajnc Matjaž.2015. Synthesis, curing kinetics, thermal and mechanical behavior of novel cardanol-based benzoxazines. *Polymer*, 76: 203-212

Anderson Jane. 2004. Green Guide to Composites: An Environmental Profiling System for Composite Materials and Products (BR 475) (Building Research). *Published by BRE Bookshop*, ISBN-13: 978-1860817335

Andrade Teresinha de Jesus Aguiar dos Santos, Araújo Bruno Quirino, Citó Antonia Maria das Graças Lopes, da Silva Juliana, Saffi Jenifer, Richter Marc François, Ferraz Alexandre de Barros Falcão. 2011. Antioxidant properties and chemical composition of technical Cashew Nut Shell Liquid (tCNSL). *Food Chemistry*, 126(3): 1044-1048

Anuar H., Zuraida A.,2011. Improvement in mechanical properties of reinforced thermoplastic elastomer composite with kenaf bast fiber. *Composites Part B: Engineering*, 42(3): 462-465

Araújo J.R., Waldman W.R., De Paoli M.A.,2008. Thermal properties of high density polyethylene composites with natural fibres: Coupling agent effect. *Polymer Degradation and Stability*, 93(10):1770-1775

Ashori Alireza, Sheshmani Shabnam. 2010. Hybrid composites made from recycled materials: Moisture absorption and thickness swelling behavior. *Bioresource Technology*, 101(12): 4717-4720

Ashori Alireza, Nourbakhsh Amir.2009. Characteristics of wood–fiber plastic composites made of recycled materials. *Waste Management*, 29(4): 1291-1295

Ashworth Sam, Rongong Jem, Wilson Peter, Meredith James.2016. Mechanical and damping properties of resin transfer moulded jute-carbon hybrid composites. *Composites Part B: Engineering*, 105: 60-66

Asim Mohammad, Jawaid Mohammad, Abdan Khalina, Ishak, Mohamad Ridzwan.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(3): 426-435

Assarar M., Scida D., El Mahi A., Poilâne C., Ayad R.,2011. Influence of water ageing on mechanical properties and damage events of two reinforced composite materials: Flax–fibers and glass–fibers. *Materials & Design*, 32(2): 788-795

ASTM D256; American Society for Testing and Materials; Standard test methods for determining the Izod pendulum impact resistance of plastics

ASTM D570; American Society for Testing and Materials; Standard test method for water absorption of plastics

ASTM D790; American Society for Testing and Materials; Standard test methods for flexural properties of unreinforced and reinforced plastics and electrical insulating materials

ASTM D1895; American Society for Testing and Materials; Standard test methods for apparent density, bulk factor, and pourability of plastic materials

ASTM D 3039; American Society for Testing and Materials; Standard test method for tensile properties of polymer matrix composites

ASTM D3801; American Society for Testing and Materials; Standard test method for measuring the comparative burning characteristics of solid plastics in a vertical position

ASTM D4065-0; American Society for Testing and Materials; Standard practice for plastics: dynamic mechanical properties: determination and report of procedures

Asumani O.M.L., Reid R.G., Paskaramoorthy R.,2012. The effects of alkali–silane treatment on the tensile and flexural properties of short fibre non-woven kenaf reinforced polypropylene composites. *Composites Part A: Applied Science and Manufacturing*, 43(9) 1431-1440

Atiqah A., Maleque M.A., Jawaid M., Iqbal M.,2014. Development of kenaf-glass reinforced unsaturated polyester hybrid composite for structural applications. *Composites Part B: Engineering*,56: 68-73

Audibert Clément, Andreani Anne-Sophie, Lainé Éric, Grandidier Jean-Claude.2018. Mechanical characterization and damage mechanism of a new flax-kevlar hybrid/epoxy composite. *Composite Structures*,195:126-135,

Azwa Z.N., Yousif B.F.,2013. Characteristics of kenaf fibre/epoxy composites subjected to thermal degradation. *Polymer Degradation and Stability*,98(12): 2752-2759

Bachtiar Dandi, Siregar Januar Parlaungan, bin Sulaiman Ahmad Syahrizan, bin Mat Rejab Mohd Ruzaimi.2014. tensile properties of hybrid sugar palm kenaf fiber reinforced polypropylene composites. *Applied Mechanics and Materials*, 695:155-158

Bajuri Farid, Mazlan Norkhairunnisa, Ishak Mohamad Ridzwan, Imatomi Junichiro.2016. Flexural and Compressive Properties of Hybrid Kenaf/Silica Nanoparticles in Epoxy Composite. *Procedia Chemistry*,19: 955-960

Balgude Dinesh Bapurao, Sabnis Anagha Shyamsunder, Ghosh Swapan Kumar.2017. Designing of cardanol based polyol and its curing kinetics with melamine formaldehyde resin. *Designed Monomers and Polymers*, 20(1): 177-189

Balgude Dinesh, Sabnis Anagha, Ghosh Swapan K.,2016. Synthesis and characterization of cardanol based aqueous 2K polyurethane coatings. *European Polymer Journal*,85: 620-634

Balgude Dinesh, Sabnis Anagha S.,2014. An environment friendly alternative for the modern coating industry. *Journal of Coatings Technology and Research*, 11(2): 169–183

Bararia Bamdad, Omrani Emad, Dorri Moghadam Afsaneh, Menezes Pradeep L., Pillai Krishna M., Rohatgi Pradeep K., 2016. Mechanical, physical and tribological characterization of nano-cellulose fibers reinforced bio-epoxy composites: An attempt to fabricate and scale the 'Green' composite. *Carbohydrate Polymers* 147: 282–293

Barreto ACH, nior AEC Ju´, Freitas JEB, Rosa DS, Barcellos WM, Freire FNA, Fechine PBA, Mazzetto SE. 2012. Biocomposites from dwarf-green Brazilian coconut impregnated with cashew nut shell liquid resin. *Journal of Composite Materials*, 47(4) :459–466

Batouli Seyed Mostafa, Zhu Yimin, Nar Mangesh, D'Souza Nandika Anne.2014. Environmental performance of kenaf-fiber reinforced polyurethane: a life cycle assessment approach. *Journal of Cleaner Production*, 66: 164-173

Biswal S., Satapathy J. R., Achary P. G. R., Pal N. C., 2012. The Synthesis and FTIR, Kinetics and TG/DTG/DTA Study of Inter Penetrating Polymer Networks (IPNs) Derived from Polyurethanes of Glycerol Modified Castor Oil and Cardanol Based Dyes. *Journal of Polymers and the Environment*, 20(3): 788–793

Bhargava Vikram, 2016. UL certification and why it is important to plastics part designers. https://dfmpro.geometricglobal.com/2016/09/22/ul-certification-important-plastics-part-designers. 22 September 2016

Boeing environmental technologies.2003. Composite Recycling and Disposal An Environmental R&D Issue, 8(4):1-4

Bourguignon Marie, Moore Kenneth, Lenssen Andrew, Archontoulis Sotirios, Goff Ben, Baldwin Brian.2016. Kenaf productivity and morphology, when grown in Iowa and in Kentucky. *Industrial Crops and Products*,94: 596-609

Chard J.M., Creech G., Jesson D.A., Smith P.A.,2011. Green composites: sustainability and mechanical performance.*18th international conference on composite materials*

Chen Jie, Liu Zengshe, Li Xiaoying, Liu Peng, Jiang Jianchun, Nie Xiaoan.2016. Thermal behavior of epoxidized cardanol diethyl phosphate as novel renewable plasticizer for poly(vinyl chloride). *Polymer Degradation and Stability*, 126: 58-64

Chen Po-Yuan, Lian Hong-Yuan, Shih Yeng-Fong, Chen-Wei Su-Mei, Jeng Ru-Jong.2017. Preparation, characterization and crystallization kinetics of Kenaf fiber/multi-walled carbon nanotube/polylactic acid (PLA) green composites. *Materials Chemistry and Physics*, 196: 249-255

Cherrington R., Goodship V., Meredith J., Wood B.M., Coles S.R., Vuillaume A., Feito-Boirac A., Spee F., Kirwan Kerry.2012 Producer responsibility: defining the incentive for recycling composite wind turbine blades in Europe. *Energy Policy*, 47 :13-21

Cicala G., Pergolizzi E., Piscopo F., Carbone D., Recca G.,2018., Hybrid composites manufactured by resin infusion with a fully recyclable bioepoxy resin. *Composites Part B: Engineering*, 132: 69-76

Clarke J.L.,2005. Structural Design of Polymer Composites: Eurocomp Design Code and Background Document. *E & FN Spon*, ISBN-13: 978-0419194507,672 pages

Darroman Emilie, Durand Nelly, Boutevin Bernard, Caillol Sylvain.2015. New cardanol/sucrose epoxy blends for biobased coatings. *Progress in Organic Coatings*, 83: 47-54

Darroman Emilie, Durand Nelly, Boutevin Bernard, Caillol Sylvain.2008. Improved cardanol derived epoxy coatings. *Progress in Organic Coatings*, 91: 9-16

Das T. K., Lenka S.,2011. Thermal and X-Ray Diffraction Studies on Interpenetrating Polymer Networks of Castor Oil-Based Polyurethane and Cardanol- Based Dyes. *Polymer-Plastics Technology and Engineering*, 50(5): 481-484

Datta Janusz, Kopczyńska Patrycja. 2015. Effect of kenaf fibre modification on morphology and mechanical properties of thermoplastic polyurethane materials. *Industrial Crops and Products*. 74: 566-576

Davoodi M.M., Sapuan S.M., Ahmad D., Aidy A., Khalina A., Jonoobi M.,2012. Effect of polybutylene terephthalate (PBT) on impact property improvement of hybrid kenaf/glass epoxy composite. *Materials Letters*, 67(1): 5-7

Davoodi M.M., Sapuan S.M., Ahmad D., Ali Aidy, Khalina A., Jonoobi Mehdi.2010. Mechanical properties of hybrid kenaf/glass reinforced epoxy composite for passenger car bumper beam. *Materials & Design*,31(10): 4927-4932

Deka Harekrishna, Misra Manjusri, Mohanty Amar. 2013. Renewable resource based "all green composites" from kenaf biofiber and poly(furfuryl alcohol) bioresins. *Industrial Crops and Products*, 41: 94-101

Deng Peng, Shi Yan, Liu Yuansen, Liu Yuan, Wang Qi.2018. Solidifying process and flame retardancy of epoxy resin cured with boron-containing phenolic resin. *Applied Surface Science*, 427, Part A: 894-904

Devi Archana, Srivastava Deepak.2007. Studies on the blends of cardanol-based epoxidized novolac type phenolic resin and carboxyl-terminated polybutadiene (CTPB), I. *Materials Science and Engineering*: A, 458(1–2):336-347

Dhakal H.N., Zhang Z.Y., Richardson M.O.W.,2007. Effect of water absorption on the mechanical properties of hemp fibre reinforced unsaturated polyester composites. *Composites Science and Technology*,67(7): 1674-1683

Dittenber David B., Gangarao Hota V.S.,2012. Critical review of recent publications on use of natural composites in infrastructure. Composites Part A: *Applied Science and Manufacturing Articles*, 43(8):1419-1429

Doan Thi-Thu-Loan, Brodowsky Hanna, Mäder Edith.2012. Jute fibre/epoxy composites: Surface properties and interfacial adhesion. *Composites Science and Technology*, 72(10):1160-1166

Dolo Guillaume, Férec Julien, Cartié Denis, Grohens Yves, Ausias Gilles. 2017. Model for thermal degradation of carbon fiber filled poly(ether ether ketone). *Polymer Degradation and Stability*,143: 20-25

Du Yicheng, Wu Tongfei, Yan Ning, Kortschot Mark T., Farnood Ramin. 2014. Fabrication and characterization of fully biodegradable natural fiber-reinforced poly(lactic acid) composites. *Composites Part B: Engineering*, 56: 717-723

Duc F., Bourban P.E., Plummer C.J.G., Månson J.-A.E.,2014. Damping of thermoset and thermoplastic flax fibre composites. *Composites Part A: Applied Science and Manufacturing*, 64: 115-123

Edeerozey A.M. Mohd, Akil Hazizan Md, Azhar A.B., Ariffin M.I. Zainal.2007. Chemical modification of kenaf fibers. *Materials Letters*, 61(10): Pages 2023-2025

El-Shekeil Y.A., Sapuan S.M., Jawaid M., Al-Shuja'a O.M.,2014. Influence of fiber content on mechanical, morphological and thermal properties of kenaf fibers reinforced poly(vinyl chloride)/thermoplastic polyurethane poly-blend composites. *Materials & Design*, 58: 130-135

Faruk Omar, Bledzki Andrzej K., Fink Hans-Peter, Sain Mohini. 2012. Biocomposites reinforced with natural fibers: 2000–2010. *Progress in Polymer Science*, 37(11): 1552-1596

Ferrante L., Tirillò J., Sarasini F., Touchard F., Ecault R., Urriza M.A. Vidal, Chocinski-Arnault L., Mellier D.,2015. Behaviour of woven hybrid basalt-carbon/epoxy composites subjected to laser shock wave testing: Preliminary results. *Composites Part B: Engineering*, 78: 162-173

Ferri Enrico, Talentino Debi. 2011. Bio-resins from cashew nutshell oil. *Reinforced Plastics*, 55(3): 29-31

Flynn Jeff, Amiri Ali, Ulven Chad.2016. Hybridized carbon and flax fiber composites for tailored performance. *Materials & Design*,102: 21-29

Fouquet Thierry, Puchot Laura, Verge Pierre, Bomfim João A.S., Ruch David.2014. Exploration of cardanol-based phenolated and epoxidized resins by size exclusion chromatography and MALDI mass spectrometry. *Analytica Chimica Acta*, 843: 46-58,

Fraga A.N., Frullloni E., Osa O. de la, Kenny J.M., Vázquez A.,2006. Relationship between water absorption and dielectric behavior of natural fiber composite materials. Polymer Testing, 25(2):181-187

Franco P.J. Herrera, González A. Valadez. 2005. A study of the mechanical properties of short natural-fiber reinforced composites. *Composites Part B: Engineering*,36(8): 597-608

Fukui R., Odai T., Zushi H., Ohsawa I., Uzawa K., Takahashi J.,2005. Recycle of carbon fiber reinforced plastics for automotive application. Proc. of *9th Japan International SAMPE Symposium,* 44–49

Ghahramani, Saeed. 2000. Fundamentals of Probability (2nd Edition). Prentice Hall: New Jersey. p. 438

Ghani M.A.A., Salleh Z., Hyie Koay Mei, Berhan M.N., Taib Y.M.D., Bakri M.A.I.,2012. Mechanical Properties of Kenaf/Fiberglass Polyester Hybrid Composite. *Procedia Engineering*, 41: 1654-1659

Grant A.,2005. Sporting composites. *Reinforced Plastics*, 49(5):46–9

Greco Antonio, Maffezzoli Alfonso.2016a. Cardanol derivatives as innovative bio-plasticizers for poly- (lactic acid). *Polymer Degradation and Stability*, 132: 213-219

Greco Antonio, Ferrari Francesca, Maffezzoli Alfonso.2016b. Effect of the epoxidation yield of a cardanol derivative on the plasticization and durability of soft PVC. *Polymer Degradation and Stability*, 134: 220-226

Greco A., Maffezzoli A., Buccoliero G., Caretto F., Cornacchia G.,2012. Thermal and chemical treatments of recycled carbon fibers for improved adhesion to polymeric matrix. *Journal of composite materials*, 47(3): 369-377

Gu Junwei, Yang Xutong, Lv Zhaoyuan, Li Nan, Liang Chaobo, Zhang Qiuyu.2016. Functionalized graphite nanoplatelets/epoxy resin nanocomposites with high thermal conductivity. *International Journal of Heat and Mass Transfer*,92: 15-22

Guo Yichen, Chang Chung-Chueh, Halada Gary, Cuiffo Michael A., Xue Yuan, Zuo Xianghao, Pack Seongchan, Zhang Linxi, He Shan, Weil Edward, Rafailovich Miriam H.,2017. Engineering flame retardant biodegradable polymer nanocomposites and their application in 3D printing. *Polymer Degradation and Stability*, 137: 205-215

Haameem M. J.A., Abdul Majid M.S., Afendi M., Marzuki H.F.A., Hilmi E. Ahmad, Fahmi I., Gibson A.G.,2016. Effects of water absorption on Napier grass fibre/polyester composites. *Composite Structures*, 144: 138-146

Hao Ayou, Zhao Haifeng, Chen Jonathan Y., 2013. Kenaf/polypropylene nonwoven composites: The influence of manufacturing conditions on mechanical, thermal, and acoustical performance. *Composites Part B: Engineering*, 54: 44-51

Haq Mahmoodul, Burgueño Rigoberto, Mohanty Amar K., Misra Manjusri. 2008. Hybrid bio-based composites from blends of unsaturated polyester and soybean oil reinforced with nanoclay and natural fibers. *Composites Science and Technology*, 68 (15): 3344-3351

Hassanin Ahmed H., Hamouda Tamer, Candan Zeki, Kilic Ali, Akbulut Turgay.2016. Developing high-performance hybrid green composites. *Composites Part B: Engineering*,92: 384-394

Herrera-Kao Wilberth, Aguilar-Vega Manuel.1999. Storage modulus changes with temperature in poly(vinyl alcohol), PVA,/poly(acrylic acid), PAA, blends. *Polymer Bulletin*, 42(4): 449–456

Hirschler M.M., 2000. chemical aspects of thermal decomposition of polymeric materials, Fire Retardancy of Polymeric Materials, Chapter 2*, CRC Press, Technology & Engineering* : 592 pages

Horrocks A., Kandola B.,2005. flammability and fire resistance of composites, Design and Manufacture of Textile Composites, chapter 9, *Elsevier, Technology & Engineering* :492 pages

Hossain Mohammad K., Dewan Mohammad W., Hosur Mahesh, Jeelani Shaik.2011. Mechanical performances of surface modified jute fiber reinforced biopol nanophased green composites. *Composites Part B: Engineering*, 42(6): 1701-1707

Ibraheem Sameer Adnan, Sreenivasan Subramania Sarma, Abdan Khalina, Sulaiman Shamsuddin A., Ali Aidy and Abdul Majid Dayang Laila Abang. 2016. The effects of combined chemical treatments on the mechanical properties of three grades of sisal. *Bioresources*, 11(4):8968-8980

Idumah Christopher Igwe, Hassan Azman.2016. Characterization and preparation of conductive exfoliated graphene nanoplatelets kenaf fibre hybrid polypropylene composites. *Synthetic Metals*,212: 91-104

Ishak M. R., Sapuan S. M., Leman Z., Rahman M. Z. A., Anwar U. M. K.,2012. Characterization of sugar palm (Arenga pinnata) fibres Tensile and thermal properties. *Journal of Thermal Analysis and Calorimetry*, 109(2): 981–989

Ishak M. R., Leman Z., Sapuan S. M., Edeerozey A. M. M., Othman I. S.,2010. Mechanical properties of kenaf bast and core fibre reinforced unsaturated polyester composites. *IOP Conf. Series: Materials Science and Engineering*, 11(1): 012006

Islam Md. Saiful, Binti Hasbullah Nur Atiqah, Hasan Mahbub, Talib Zainal Abidin, Jawaid M., Haafiz M.K. Mohamad.2015. Physical, mechanical and biodegradable properties of kenaf/coir hybrid fiber reinforced polymer nanocomposites. *Materials Today Communications*, 4: 69-76

Islama Md. Saiful, Binti Hasbullaha Nur Atiqah, Hasanb Mahbub, Talibc Zainal Abidin, Jawaid M., Haafize M.K. Mohamad.2015. Physical, mechanical and biodegradable properties of kenaf/coirhybrid fiber reinforced polymer nanocomposites. *Materials Today Communications*, 4: 69–76

Jabbar Abdul, Militký Jiří, Kale Bandu Madhukar, Rwawiire Samson, Nawab Yasir, Baheti Vijay. 2016. Modeling and analysis of the creep behavior of jute/green epoxy composites incorporated with chemically treated pulverized nano/micro jute fibers. *Industrial Crops and Products,* 84: 230-240

Jacob Maya, Francis Bejoy, Thomas Sabu. 2006. Dynamical Mechanical Analysis of Sisal/Oil Palm Hybrid Fiber-Reinforced Natural Rubber Composites. *Polymer Composites*, 27(6): 671–680

Jambari Sharoul, Yazid Yahya Muhamad, Ruslan Abdullah Mohamed, Jawaid Mohammad. 2017. Woven kenaf/kevlar hybrid Yarn as potential fiber reinforced for anti-ballistic composite material. *Fibers and Polymers*, 18(3): 563–568

James M.,2010. Recycled nonwoven materials for the future: from fuel cells to aerospace. *13th Annual global outlook for carbon fiber*, Barcelo Valencia, Spain

Jawaid M., Abdul Khalil H. P. S..2011a. effect of layering pattern on the dynamic mechanical properties and thermal degradation of oil palm jute fibers reinforced epoxy hybrid composite. *BioResources*, 6(3):2309-2322

Jawaid M., Abdul Khalil H.P.S.,2011b. Cellulosic/synthetic fibre reinforced polymer hybrid composites: A review. *Carbohydrate Polymers*, 86(1): 1-18

Jawaid. M, Abdul Khalil H. P. S., Bakar. A.A., 2011a. Woven hybrid composites: Tensile and flexural properties of oil palm-woven jute fibres based epoxy composites. *Materials Science and Engineering A*: 528(15):5190-5195

Jawaid M., Abdul Khalil H.P.S., Abu Bakar A., Khanam P. Noorunnisa.2011b. Chemical resistance, void content and tensile properties of oil palm/jute fibre reinforced polymer hybrid composites. *Materials & Design*, 32(2): 1014-1019

Job, S.,2010. Composite Recycling-Summary of recent research and development. *Knowledge Transfer Network-Materials*,1:1-25

Joseph P.V, Rabello Marcelo S, Mattoso L.H.C, Joseph Kuruvilla, Thomas Sabu.2002. Environmental effects on the degradation behaviour of sisal fibre reinforced polypropylene composites. *Composites Science and Technology*, 62(10–11):1357-1372,

Joseph Seena, Sreekala M.S., Oommen Z., Koshy P., Thomas Sabu.2002. A comparison of the mechanical properties of phenol formaldehyde composites reinforced with banana fibres and glass fibres. *Composites Science and Technology*,62(14): 1857-1868

Kabir M.M., Wang H., Lau K.T., Cardona F.,2012. Chemical treatments on plant-based natural fibre reinforced polymer composites: An overview. *Composites Part B: Engineering*, 43(7): 2883-2892

Kaboorani Alireza.2017. Characterizing water sorption and diffusion properties of wood/plastic composites as a function of formulation design. Construction and Building Materials, 136: 164-172

Kandar M.I. Mat, Akil H.M.,2016. Application of Design of Experiment (DoE) for Parameters Optimization in Compression Moulding for Flax Reinforced Biocomposites. *Procedia Chemistry,* 19: 433-440

Kandola Baljinder K., Ebdon John R., Luangtriratana Piyanuch, Krishnan Latha.2016. Novel flame retardant thermoset resin blends derived from a free-radically cured vinylbenzylated phenolic novolac and an unsaturated polyester for marine composites. *Polymer Degradation and Stability*,127: 56-64

Kanehashi Shinji, Oyagi Hiroki, Lu Rong, Miyakoshi Tetsuo. 2014. Development of bio-based hybrid resin, from natural lacquer. *Progress in Organic Coatings*, 77 (1): 24-29

Karimi Samaneh, Tahir Paridah Md., Karimi Ali, Dufresne Alain, Abdulkhani Ali.2014. Kenaf bast cellulosic fibers hierarchy: A comprehensive approach from micro to nano. *Carbohydrate Polymers*, 101: 878-885

Kasemsiri Pornnapa, Hiziroglu Salim, Rimdusit Sarawut.2011. Properties of wood polymer composites from eastern redcedar particles reinforced with benzoxazine resin/cashew nut shell liquid copolymer. Composites Part A: Applied Science and Manufacturing, 42(10): 1454-1462

Kasiraman G., Geo V. Edwin, Nagalingam B.,2016. Assessment of cashew nut shell oil as an alternate fuel for CI (Compression ignition) engines. *Energy*,101: 402-410

Khan, A. R.,2010. Kenaf, a fiber for future: The Harusmas experience. *JEC Composite Magazine*, 21–23

Khanlou Hossein Mohammad, Woodfield Peter, Summerscales John, Hall Wayne.2017. Consolidation process boundaries of the degradation of mechanical properties in compression molding of natural-fiber bio-polymer composites. Polymer Degradation and Stability, 138:115-125

Kiani Golnar, Ibrahim Rahinah, Abdan Kalinah. 2016. Pre preparation of kenaf/carbon/PPL composite to be employed in selective laser sintering machine. *Alam Cipta*, 9(2): 6 pages

Kim Kwan-Woo, Lee Hye-Min, An Jeong-Hun, Chung Dong-Chul, An Kay-Hyeok, Kim Byung-Joo. 2017. Recycling and characterization of carbon fibers from carbon fiber reinforced epoxy matrix composites by a novel super-heated-steam method. *Journal of Environmental Management*, xxx: 1-8

Kiruthika A.V.,2017. A review on physico-mechanical properties of bast fiber reinforced polymer composites. Journal of Building Engineering, 9: 91-99

Kitamura Takanori, Zhang Zhiyuan, Suda Mitsunori, Ito Kanta, Teramura Suguru, Kitai Keisuke, Hamada Hiroyuki. 2016. Application of Paper Processing on Carbon, Jute and Paper Fiber Reinforced Plastic. *Energy Procedia*,89: 231-238

Koronis Georgios, Silva Arlindo, Fontul Mihail.2013. Green composites: A review of adequate materials for automotive applications. *Composites Part B: Engineering*, 44(1): 120-127

Kozlowski, R. (2000). Potential and diversified uses of green fibers.2000. *3rd international wood and natural fibers composites symposium Kassel, Germany*.

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

Ku H., Cardona F., Ball J., Jacobson W., Trada M.,2008. Relationship Between Electrical and Mechanical Loss Tangents of SLG Reinforced Phenolic Composites: Pilot Study. *Journal of Composite Materials*,42(19):2083 – 2095

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

Kwon Hyeok-Jin, Sunthornvarabhas Jackapon, Park Ji-Won, Lee Jung-Hun, Kim Hyun-Joong, Piyachomkwan Kuakoon, Sriroth Klanarong, Cho Donghwan.2014. Tensile properties of kenaf fiber and corn husk flour reinforced poly(lactic acid) hybrid bio-composites: Role of aspect ratio of natural fibers. *Composites Part B: Engineering*,56: 232-237

Kwon Yeon Ju, Kim Youn, Jeon Hyerin, Cho Sehyeon, Lee Wonoh, Lee Jea Uk. 2017. Graphene/carbon nanotube hybrid as a multi-functional interfacial reinforcement for carbon fiber-reinforced composites. *Composites Part B: Engineering*, 122: 23-30, Lagel M.C., Hai L., Pizzi A., Basso M.C., Delmotte L., Abdalla S., Zahed A., Al-Marzouki F.M., 2016. Automotive brake pads made with a bioresin matrix. *Industrial Crops and Products*, 85: 372-381

Lam Thi Bach Tuyet, Hori Keko, Iiyama Kenji .2003. Structural characteristics of cell walls of kenaf (*Hibiscus cannabinus* L.) and fixation of carbon dioxide. *Journal of Wood Science*, 49(3): 255–261

La Mantia F.P., Morreale M.,2011. Green composites: A brief review. *Composites Part A: Applied Science and Manufacturing*, 42(6): 579-588

Laoutid F., Bonnaud L., Alexandre M., Lopez-Cuesta J.-M., Dubois Ph.,2009. New prospects in flame retardant polymer materials: From fundamentals to nanocomposites. *Materials Science and Engineering: R: Reports*, 63(3): 100-125

Ling Pang Ai, Ismail Hanafi, Abu Bakar Azhar.2016. Influence of Kenaf (KNF) Loading on Processing Torque and Water Absorption Properties of KNF-Filled Linear Low-Density Polyethylene/Poly (vinyl alcohol) (LLDPE/PVA) Composites. *Procedia Chemistry*,19: 505-509

Liu Wanjun, Drzal Lawrence T., Mohanty Amar K., Misra Manjusri. 2007. Influence of processing methods and fiber length on physical properties of kenaf fiber reinforced soy based biocomposites. *Composites Part B: Engineering*, 38(3):352-359

Lucia L. A., Rojas, O. J.,2009. The nanoscience and technology of renewable biomaterials. *Wiley-Blackwell*, ISBN: 978-1-4051-6786-4, 366 pages

Lyon Richard E., Takemori Michael T., Safronava Natallia, Stoliarov Stanislav I., Walters Richard N., 2017. A molecular basis for polymer flammability. *Polymers*, 50 (12) :2608-2617

Maffezzoli Alfonso, Calò Emanuela, Zurlo Simona, Mele Giuseppe, Tarzia Antonella, Stifani Cristina. 2004. Cardanol based matrix biocomposites reinforced with natural fibres. *Composites Science and Technology*,64(6): 839-845

Mahjoub Reza, Yatim Jamaludin Mohamad, Mohd Sam Abdul Rahman, Hashemi Sayed Hamid.2014a. Tensile properties of kenaf fiber due to various conditions of chemical fiber surface modifications, *Construction and Building Materials*, 55: 103-113

Mahjoub Reza, Yatim Jamaludin Mohamad, Mohd Sam Abdul Rahman, Raftari Mehdi. 2014b. Characteristics of continuous unidirectional kenaf fiber reinforced epoxy composites. *Materials & Design*, 64: 640-649

Majid R.A., Ismail H., Taib R.M.,2016. Benzoyl Chloride Treatment of Kenaf Core Powder: The Effects on Mechanical and Morphological Properties of PVC/ENR/kenaf Core Powder Composites. *Procedia Chemistry*, 19: 803-809

Mansor M.R., Sapuan S.M., Zainudin E.S., Nuraini A.A., Hambali A.,2013. Hybrid natural and glass fibers reinforced polymer composites material selection using Analytical Hierarchy Process for automotive brake lever design. *Materials & Design*, 51: 484-492

Markarian Jennifer.2008. Outdoor living space drives growth in wood-plastic composites. *Plastics, Additives and Compounding*, 10(4): 20-25

Mariatti M., Jannah M., Abu Bakar A., Abdul Khalil H. P. S.,2008. Properties of Banana and Pandanus Woven Fabric Reinforced Unsaturated Polyester Composites. *Journal of Composite Materials*,42(9): 931-941

Marsh G., 2008. Reclaiming value from post-use carbon composite. *Reinforced Plastics* ,52(7):36–9

Marsh G. Airframers exploit composites in battle for supremacy.2005. *Reinforced Plastics*, 49(3):26–32

Martel Gilles-Philippe Picher, Levy Arthur, Hubert Pascal.2016. Compression molding of Carbon/PEEK Randomly-Oriented Strands composites: A 2D Finite Element model to predict the squeeze flow behavior. *Composites Part A: Applied Science and Manufacturing*, 81: Pages 69-77,

Maslinda A.B., Abdul Majid M.S., Ridzuan M.J.M., Afendi M., Gibson A.G.,2017. Effect of water absorption on the mechanical properties of hybrid interwoven cellulosic-cellulosic fibre reinforced epoxy composites. *Composite Structures*,167: 227-237

Meng F., McKechnie J., Turner T.A., Pickering S.J.,2017. Energy and environmental assessment and reuse of fluidised bed recycled carbon fibres. *Composites Part A: Applied Science and Manufacturing*, 100: 206-214

Menon A.R.R., Pillai C.K.S., Sudha J.D., Mathew A.G.,1985. Cashew nut shell liquid – its polymeric and other industrial product. *Journal of scientific and industrial research*, 44(6):324–338

Meredith James, Cozien-Cazuc Sophie, Collings Ed, Carter Sam, Alsop Stewart, Lever Jon, Coles Stuart R., Wood Benjamin M., Kirwan Kerry.2012. Recycled carbon fiber for high performance energy absorption. *Composites Science and Technology*, 72(6): 688-695

Mngomezulu Mfiso E., John Maya J., Jacobs Valencia, Luyt Adriaan S.,2014. Review on flammability of biofibres and biocomposites. *Carbohydrate Polymers*, 111: 149-182

Mohanty A. K., Khan Mubarak A., Sahoo S., Hinrichsen G.,2000a. Effect of chemical modification on the performance of biodegradable jute yarn-Biopol® composites. *Journal of Materials Science*, 35(10): 2589–2595

Mohanty A. K., Misra M., Hinrichsen G.,2000b. Biofibres, biodegradable polymers and biocomposites: An overview. *Macromolecular Materials and Engineering*, 276-277(1):1-24

Morin Christelle, Loppinet-Serani Anne, Cansell François, Aymonier Cyril.2012. Near- and supercritical solvolysis of carbon fiber reinforced polymers (CFRPs) for recycling carbon fibers as a valuable resource: State of the art. *The Journal of Supercritical Fluids*, 66: 232-240

Mothé Cheila Gonçalves,Vieira Cristiane Rocha, Mothé Michelle Gonçalves.2013. Thermal and surface study of phenolic resin from cashew nut shell liquid cured by plasma treatment. *Journal of Thermal Analysis and Calorimetry*, 114(2): 821–826

Mwaikambo L.Y., Ansell M.P.,2003. Hemp fibre reinforced cashew nut shell liquid composites. *Composites Science and Technology*, 63(9): 1297-1305

Mythili C. V., Malar Retna A., Gopalakrishnan S.,2004. Synthesis, mechanical, thermal and chemical properties of polyurethanes based on cardanol. *Bulletin of Materials Science*. 27(3): 235–241

Nady H., El-Rabiei M.M., Abd El-Hafez G.M.,2017. Electrochemical oxidation behavior of some hazardous phenolic compounds in acidic solution, *Egyptian Journal of Petroleum*, 26(3):669-678,

Nahil Mohamad Anas, Williams Paul T.,2011. Recycling of carbon fiber reinforced polymeric waste for the production of activated carbon fibers. *Journal of Analytical and Applied Pyrolysis*, 91(1): 67-75

Nair Reghunadhan C.P.,2004. Advances in addition-cure phenolic resins. *Progress in Polymer Science*, 29(5): 401-498

Nair K.C Manikandan, Thomas Sabu, Groeninckx G.,2001. Thermal and dynamic mechanical analysis of polystyrene composites reinforced with short sisal fibres. *Composites Science and Technology*, 61(16): 2519-2529

Natarajan M., Murugavel S. C.,2017. Thermal stability and thermal degradation kinetics of bio-based epoxy resins derived from cardanol by thermogravimetric analysis. *Polymer Bulletin*, 74(8): 3319–3340

Nayak Rati Ranjan, Ray Gyanjit, Lenka Subasini.2009. Thermal and X-Ray Diffraction Studies on Interpenetrating Polymer Networks of Soybean Oil-Based Polyurethane and Cardanol-Based Dye. *Polymer-Plastics Technology and Engineering*,48(5): 503-508

Netnapa E., Mariatti M., Hamid Z.A.A., Todo M., Banhan L.,2016. Dielectric Breakdown Strength and Flammability Properties of Flame Retardant Filler/PLLA-PLA Microsphere/Kenaf Fiber Composites. *Procedia Chemistry*,19: 290-296

Niaz Akhtar Majid, Sulong Abu Bakar, Radzi M.K. Fadzly, Ismail N.F., Raza M.R., Muhamad Norhamidi, Khan Muhammad Azhar. 2016. Influence of alkaline treatment and fiber loading on the physical and mechanical properties of kenaf/polypropylene composites for variety of applications. *Progress in Natural Science: Materials International*, 26(6): 657-664

Niimura Noriyasu, Miyakoshi Tetsuo.2003. Structural Characterization of Cashew Resin Film Using Two-Stage Pyrolysis-Gas Chromatography/Mass Spectrometry. *International Journal of Polymer Analysis and Characterization*, 8(1): 47-66

Nirmal Umar, Singh Narish, Hashim Jamil, Lau Saijod T.W., Jamil Nadia. 2011. On the effect of different polymer matrix and fibre treatment on single fibre pullout test using betelnut fibres. *Materials & Design*, 32(5): 2717-2726

Nishino Takashi, Hirao Koichi, Kotera Masaru, Nakamae Katsuhiko, Inagaki Hiroshi. 2003. Kenaf reinforced biodegradable composite. *Composites Science and Technology*, 63(9): 1281-1286

Ochi Shinji. 2010. Tensile properties of kenaf fiber bundle. *SRX Materials Science*, Article ID 152526, 6 pages

Otto Guilherme Piovezan, Moisés Murilo Pereira, Carvalho Gizilene, Rinaldi Andrelson Wellington, Garcia Juliana Carla, Radovanovic Eduardo, Fávaro Silvia Luciana. 2017. Mechanical properties of a polyurethane hybrid composite with natural lignocellulosic fibers. *Composites Part B: Engineering*,110: 459-465

Özturk Sultan. 2010. Effect of Fiber Loading on the Mechanical Properties of Kenaf and Fiberfrax Fiber-reinforced Phenol-Formaldehyde Composites. *Journal of Composite Materials*, 44(19): 2265 – 2288

Özturk Sultan. 2005. The effect of fibre content on the mechanical properties of hemp and basalt fibre reinforced phenol formaldehyde composites. *Journal of Materials Science*, 40(17): 4585–4592

Pang E.J.X., Pickering S.J., Chan A., Wong K.H.,2012. Use of recycled carbon fiber as a heating element. *Journal of composite materials*, 47(16): 2039-2050

Paridah M.T., Juliana A.H., El-Shekeil Y.A., Jawaid M., Alothman O.Y.,2014. Measurement of mechanical and physical properties of particleboard by hybridization of kenaf with rubberwood particles. *Measurement*, 56: 70-80

Paridah Md. Tahir, Basher Amel B., SaifulAzry Syeed, Ahmed Zakiah.2011. retting process of some bast plant fibers and its effect on fiber quality a review. *BioResources,* 6(4): 5260-5281

Pfister Daniel P., Larock Richard C.,2010. Green composites from a conjugated linseed oil-based resin and wheat straw. *Composites Part A: Applied Science and Manufacturing*, 41(9): 1279-1288

Pickering K.L., Efendy M.G. Aruan, Le T.M.,2016. A review of recent developments in natural fibre composites and their mechanical performance. *Composites Part A: Applied Science and Manufacturing*, 83: 98-112

Pickering S.J.,2006. Recycling technologies for thermoset composite materials—current status. Composites Part A: *Applied Science and Manufacturing*, 37(8)1206-1215

Olmsted Thomas W., 2014. Phenolic novolac and resole resins. https://plenco.com/phenolic-novolac-resol-resins.htm

Pimenta Soraia, Pinho Silvestre T.,2012. The effect of recycling on the mechanical response of carbon fibers and their composites. *Composite Structures*, 94(12): 3669-3684

Pimenta Soraia, Pinho Silvestre T.,2011. Recycling carbon fiber reinforced polymers for structural applications: Technology review and market outlook. *Waste Management*, 31(2):378-392

Prabhakaran K., Narayanan Asha, Pavithran C.,2001. Cardanol as a dispersant plasticizer for an alumina/toluene tape casting slip. *Journal of the European Ceramic Society*, 21(16): 2873-2878

Ponnamma Deepalekshmi, Thomas Sabu. 2014. Non-Linear Viscoelasticity of Rubber Composites and Nanocomposites: Influence of Filler Geometry and Size in Different Length Scales. *Springer, Technology & Engineering* : 309 pages

Rajkumar Govindaraju, Srinivasan Jagannathan, Suvitha Latchupathi.2013. Natural protein fiber hybrid composites: Effects of fiber content and fiber orientation on mechanical, thermal conductivity and water absorption properties *Journal of Industrial Textiles*, 44(5): 709-724

Ramamoorthy Sunil Kumar, Bakare Fatimat, Herrmann Rene, Skrifvars Mikael.2015. Performance of biocomposites from surface modified regenerated cellulose fibers and lactic acid thermoset bioresins. *Cellulose*, 22:2507–2528

Ramesh M.,2016. Kenaf (L.) fibre based bio-materials: A review on processing and properties. *Progress in Materials Science*, 78: 1-92

Ramesh M., Palanikumar K., Reddy K. Hemachandra. 2013: Mechanical property evaluation of sisal–jute–glass fiber reinforced polyester composites. *Composites Part B: Engineering*, 48:1-9

Rana R.S., kumre Ashish, Rana Saraswati, Purohit Rajesh.2017. Characterization of Properties of epoxy sisal / Glass Fiber Reinforced hybrid composite. *Materials Today: Proceedings*,4(4): 5445-5451

Rao B.S., Palanisamy Aruna. 2012. A new thermo set system based on cardanol benzoxazine and hydroxy benzoxazoline with lower cure temperature. *Progress in Organic Coatings*, 74(3): 427-434

Rao B.S., Palanisamy Aruna.2011. Monofunctional benzoxazine from cardanol for bio-composite applications. *Reactive and Functional Polymers*, 71(2): 148-154

Rashid Bushra, Leman Zulkiflle, Jawaid Mohammad, Ghazali Mariyam Jameelah , Ishak Mohamad Ridzwan. 2016. the mechanical performance of sugar palm fiber (ijuk) reinforced phenolic composites. *International Journal of Precision Engineering and Manufacturing,*17(8): 1001–1008

Razak NI, Ibrahim NA, Zainuddin N, Rayung M, Saad WZ. 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(3): 2957-68

Rojo Ester, Alonso M. Virginia, Oliet Mercedes, Saz-Orozco Belén Del, Rodriguez Francisco.2015. Effect of fiber loading on the properties of treated cellulose fiber-reinforced phenolic composites. *Composites Part B: Engineering*, 68:185-192

Rowell R.M..2008. Natural fibres: types and properties. Woodhead Publishing Series in Composites Science and Engineering, edited by Kim L. Pickering, *Woodhead Publishing*: 3-66,

Rush Susan.2007.Carbon fiber: Life Beyond the Landfill , High-Performance Composites, *Composite worlds*

Saba N., Paridah M.T., Abdan K., Ibrahim N.A.,2016a. Dynamic mechanical properties of oil palm nano filler/kenaf/epoxy hybrid nanocomposites. *Construction and Building Materials*, 124: 133-138

Saba N., Paridah M.T., Abdan K., Ibrahim N.A.,2016b. Physical, structural and thermomechanical properties of oil palm nano filler/kenaf/epoxy hybrid nanocomposites. *Materials Chemistry and Physics*, 184: 64-71

Saba N., Jawaid M., Alothman Othman Y., Paridah M.T.,2016c. A review on dynamic mechanical properties of natural fibre reinforced polymer composites. *Construction and Building Materials*,106: 149-159

Saba N., Paridah M.T., Jawaid M., 2015a. Mechanical properties of kenaf fibre reinforced polymer composite: A review. *Construction and Building Materials*, 76: 87-96

Saba N., Paridah M., Jawaid M., Abdan K., Ibrahim N.,2015b. Potential Utilization of Kenaf Biomass in Different Applications. In: Hakeem K., Jawaid M., Y. Alothman O. (eds) Agricultural Biomass Based Potential Materials. *Springer*, Cham

Saba N, Tahir P, Jawaid M.,2014. A review on potentiality of nano filler/natural fiber filled polymer hybrid composites. *Polymers*, 6(8):2247–2273

Salleh Z., Hyie Koay Mei, Berhan M.N., Taib Y.M.D., Latip E.N.A., Kalam Anizah.2014. Residual Tensile Stress of Kenaf Polyester and Kenaf Hybrid under Post Impact and Open Hole Tensile. *Procedia Technology*, 15: 856-861

Salleh Z., Berhan M.N., Hyie Koay Mei, Taib Y.M., Kalam A., Nik Roselina N.R.,2013. Open Hole Tensile Properties of Kenaf Composite and Kenaf/Fibreglass Hybrid Composite Laminates. *Procedia Engineering*,68: 399-404

Salleh Z., Taib Y.M., Hyie Koay Mei, Mihat M., Berhan M.N., Ghani M.A.A.,2012. Fracture Toughness Investigation on Long Kenaf/Woven Glass Hybrid Composite Due To Water Absorption Effect. *Procedia Engineering*,41: 1667-1673

Sanjay M.R., Madhu P., Jawaid Mohammad, Senthamaraikannan P., Senthil S., Pradeep S.,2018. Characterization and properties of natural fiber polymer composites: A comprehensive review. *Journal of Cleaner Production*, 172: 566-581

Sanjay M.R. and Yogesha B.,2017. Studies on Natural/Glass Fiber Reinforced Polymer Hybrid Composites: An Evolution. *Materials Today: Proceedings*, 4(2): 2739-2747

Santos da Silva Reginaldo, de Souza Alexandre Araújo, De Paoli Marco-Aurelio, de Souza Cleide Maria Leite.2010. Cardanol–formaldehyde thermoset composites reinforced with buriti fibers: Preparation and characterization. *Composites Part A: Applied Science and Manufacturing*, 41(9): 1123-1129

Sapuan S.M., Pua Fei-ling, El-Shekeil Y.A., AL-Oqla Faris M.,2013. Mechanical properties of soil buried kenaf fibre reinforced thermoplastic polyurethane composites. *Materials & Design*, 50: 467-470

Sathiyalekshmi K.,1993. Studies on structure and properties of CNSL novolac resins prepared with succinic acid catalyst. *Bulletin of Materials Science*, 16(2): 137–150

Satyanarayana Kestur G., Arizaga Gregorio G.C., Wypych Fernando.2009. Biodegradable composites based on lignocellulosic fibers—An overview. *Progress in Polymer Science*, 34(9): 982-1021

Sawpan Moyeenuddin A., Pickering Kim L., Fernyhough Alan.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(9): 1189-1196

Shackelford James F.,2009. Introduction to Materials Science for Engineers. *Prentice Hall*, ISBN-13: 978-0133826654, 586 pages

Shao Liang, Ji Zhan-You, Ma Jian-Zhong, Xue Chao-Hua, Ma Zhong-Lei, Zhang Jing.2016. The Synergy of Double Crosslinking Agents on the Properties of Styrene Butadiene Rubber Foams. *Scientific Reports*, 6:36931

Shih Yeng-Fong.2007. Mechanical and thermal properties of waste water bamboo husk fiber reinforced epoxy composites. *Materials Science and Engineering*: A, 445–446: 289-295

Shukor Faseha, Hassan Azman, Islam Md. Saiful, Mokhtar Munirah, Hasan Mahbub.2014. Effect of ammonium polyphosphate on flame retardancy, thermal stability and mechanical properties of alkali treated kenaf fiber filled PLA biocomposites. *Materials & Design (1980-2015)*, 54: 425-429

Sloan J.,2011. Carbon fibre market: cautious optimism. High-performance composites, *Composite worlds*

Smith William Fortune, Hashemi Javad. 2006. Foundations of Materials Science and Engineering. *McGraw-Hill*, ISBN-13: 978-0073529240, 1032 pages

Srivastava Riya, Srivastava Deepak.2015. Mechanical, chemical, and curing characteristics of cardanol–furfural-based novolac resin for application in green coatings. *Journal of Coatings Technology and Research*,12(2): 303–311

Strong A. Brent.2006. Plastics: Materials and Processing. *Pearson Prentice Hall*. ISBN-13: 978-0131145580, 917 pages

Subasinghe Aruna, Somashekar Arcot A., Bhattacharyya Debes. 2018. Effects of wool fiber and other additives on the flammability and mechanical performance of polypropylene/kenaf composites. *Composites Part B: Engineering*, 136: 168-176

Subasinghe A.D.L., Das R., Bhattacharyya D.,2015. Fiber dispersion during compounding/injection molding of PP/kenaf composites: Flammability and mechanical properties. *Materials & Design*, 86: 500-507

Suharty Neng Sri, Ismail Hanafi, Diharjo Kuncoro, Handayani Desi Suci, Firdaus Maulidan.2016. Effect of Kenaf Fiber as a Reinforcement on the Tensile, Flexural Strength and Impact Toughness Properties of Recycled Polypropylene/Halloysite Composites. *Procedia Chemistry*, 19: 253-258

Suzuki T., Takahashi J.,2005. Prediction of energy intensity of carbon fiber reinforced plastics for mass-produced passenger cars. *9th Japan International SAMPE symposia*, Tokyo Big Sight,14-19

Suzuki T., Kan M., Takahashi J.,2004. LCA of lightweight vehicles by using CFRP for mass produced vehicles. *29th Symposium of Japan Society of Composite Materials*, 195–196

Tadini Pietro, Grange Nathan, Chetehouna Khaled, Gascoin Nicolas, Senave Samuel, Reynaud Isabelle. 2017. Thermal degradation analysis of innovative PEKK-based carbon composites for high-temperature aeronautical components. *Aerospace Science and Technology*,65: 106-116

Tanaka Shukichi, Iwata Tadahisa, Iji Masatoshi.2016. Solvent effects on heterogeneous synthesis of cardanol-bonded cellulose thermoplastics. *Polymer*,99: 307-314

Thakur Vijay Kumar, Thakur Manju Kumari. 2014. Processing and characterization of natural cellulose fibers/thermoset polymer composites. *Carbohydrate Polymers*, 109: 102-117

Tian Xiaoyong, Liu Tengfei, Wang Qingrui, Dilmurat Abliz, Li Dichen, Ziegmann Gerhard. 2017. Recycling and remanufacturing of 3D printed continuous carbon fiber reinforced PLA composites. *Journal of Cleaner Production*, 142: 1609-1618

Toyama Kiyohiko, Soyama Makoto, Tanaka Shukichi, Iji Masatoshi.2015. Development of cardanol-bonded cellulose thermoplastics: high productivity achieved in two-step heterogeneous process. *Cellulose*,22(3): 1625–1639

Tye Ying Ying, Lee Keat Teong, Wan Abdullah Wan Nadiah, Leh Cheu Peng.2016 The world availability of non-wood lignocellulosic biomass for the production of cellulosic ethanol and potential pretreatments for the enhancement of enzymatic saccharification. *Renewable and Sustainable Energy Reviews*, 60: 155-172

Unnikrishnan K. P., Thachil Eby Thomas. 2008. Synthesis and Characterization of Cardanol-Based Epoxy Systems. *Designed Monomers and Polymers*, 11(6):593-607

Vaithilingam Selvaraj, Jayanthi K.P., Muthukaruppan Alagar.2017. Synthesis and characterization of cardanol based fluorescent composite for optoelectronic and antimicrobial applications. *Polymer*, 108: 449-461

Venkateshwaran N., ElayaPerumal A., Alavudeen A., Thiruchitrambalam M.,2011. Mechanical and water absorption behaviour of banana/sisal reinforced hybrid composites. *Materials & Design*, 32(7):4017-4021

Vijayakumar S., Nilavarasan T., Usharani R., Karunamoorthy L.,2014. Mechanical and Microstructure Characterization of Coconut Spathe Fibers and Kenaf Bast Fibers Reinforced Epoxy Polymer Matrix Composites. *Procedia Materials Science*, 5: 2330-2337

Wang H.W., Zhou H.W., Gui L.L., Ji H.W., Zhang X.C.,2014. Analysis of effect of fiber orientation on Young's modulus for unidirectional fiber reinforced composites. *Composites Part B: Engineering*, 56: 733-739

Wang Shujuan, Xing Xiaolong, Wang Ya'nan, Wang Wen, Jing Xinli.2017. Influence of poly (dihydroxybiphenyl borate) on the curing behaviour and thermal pyrolysis mechanism of phenolic resin. *Polymer Degradation and Stability*, 144: 378-391

Wang W., Sain M., Cooper P.A.,2006. Study of moisture absorption in natural fiber plastic composites. Composites Science and Technology, 66(3-4): 379-386

Wong K.H., Pickering S.J., Rudd C.D.,2010. Recycled carbon fiber reinforced polymer composite for electromagnetic interference shielding. *Composites Part A: Applied Science and Manufacturing*, 41(6):693-702

Xu Shuangshuang, Han Yue, Guo Ying, Luo Zhenhua, Ye Li, Li Zheng, Zhou Heng, Zhao Yan, Zhao Tong.2017. Allyl phenolic-phthalonitrile resins with tunable properties: Curing, processability and thermal stability. *European Polymer Journal*, 95:394-405

Xue Li, Lope G. Tabil, Satyanarayan Panigrahi.2007. Chemical treatments of natural fiber for use in natural fiber-reinforced composites: a review. *Journal of Polymers and the Environment*, 15(1): 25–33

Yadav Ranjana, Srivastava Deepak .2010. Blends of cardanol-based epoxidized novolac resin and CTBN for application in surface coating: a study on thermal, mechanical, chemical, and morphological characteristics. *Journal of Coatings Technology and Research*, 7(5): 557–568

Yahaya R., Sapuan S.M., Jawaid M., Leman Z., Zainudin E.S.,2016a. Effect of fibre orientations on the mechanical properties of kenaf–aramid hybrid composites for spall-liner application. *Defence Technology*, 12(1): 52-58

Yahaya R., Sapuan S.M., Jawaid M., Leman Z., Zainudin E.S.,2016b. Measurement of ballistic impact properties of woven kenaf–aramid hybrid composites. *Measurement*, 77: 335-343

Yahaya R., Sapuan S.M., Jawaid M., Leman Z., Zainudin E.S.,2015. Effect of layering sequence and chemical treatment on the mechanical properties of woven kenaf–aramid hybrid laminated composites. *Materials & Design*, 67: 173-179

Yantaboot Kanokwan, Amornsakchai Taweechai. 2017. Effect of preparation methods and carbon black distribution on mechanical properties of short pineapple leaf fiber-carbon black reinforced natural rubber hybrid composites. *Polymer Testing*, 61: 223-228

Yousif B.F., Shalwan A., Chin C.W., Ming K.C.,2012. Flexural properties of treated and untreated kenaf/epoxy composites. *Materials & Design*, 40: 378-385

Zalewicz Małgorzata. 1989. Thermal analysis of complex salts of lanthanide chlorides with hexamethylenetetramine. *Thermochimica Acta*,149: 133-140

Zampaloni M., Pourboghrat F., Yankovich S.A., Rodgers B.N., Moore J., Drzal L.T., Mohanty A.K., Misra M.,2007. Kenaf natural fiber reinforced polypropylene composites: A discussion on manufacturing problems and solutions. *Composites Part A: Applied Science and Manufacturing*, 38(6):1569-1580

Zamri Mohd Hafiz, Akil Hazizan Md, MohdIshak Zainal Ariffin. 2016a. Pultruded Kenaf Fibre Reinforced Composites: Effect of Different Kenaf Fibre Yarn Tex. *Procedia Chemistry*, 19: 577-585

Zamri M.H., Osman M.R., Akil H.M., Shahidan M.H.A., Mohd Ishak Z.A.,2016b. Development of green pultruded composites using kenaf fibre: influence of linear mass density on weathering performance. *Journal of Cleaner Production*, 125: 320-330

Zhai Zhe, Feng Lajun, Liu Zheng, Li Guangzhao. 2016. Water absorption test for carbon fiber epoxy resin composite based on electrical resistance. *Polymer Testing*, 56: 394-397

Zhang Lei, Yang Yong, Chen Yingxin, Lu Hongwei.2017. Cardanol-capped main-chain benzoxazine oligomers for resin transfer molding. *European Polymer Journal*, 93: 284-293,

Zhang Meng, Zhang Jinwen, Chen Shuigen, Zhou Yonghong.2014. Synthesis and fire properties of rigid polyurethane foams made from a polyol derived from melamine and cardanol. *Polymer Degradation and Stability*,110: 27-34

Zhang Yongsheng, Ferdosian Fatemeh, Yuan Zhongshun, Xu Chunbao Charles.2017. Sustainable glucose-based phenolic resin and its curing with a DGEBA epoxy resin. *Journal of the Taiwan Institute of Chemical Engineers*, 71: 381-387

Zhao Yun-Hong, Zhang Ya-Fei, Bai Shu-Lin, Yuan Xiao-Wen.2016. Carbon fibre/graphene foam/polymer composites with enhanced mechanical and thermal properties. *Composites Part B: Engineering*, 94: 102-108