



ICSTD Bali 2012

Developing Sustainable Technology for a Better Future



PROCEEDINGS

2nd International Conference on
Sustainable Technology Development
(ICSTD)

*“Developing Sustainable Technology
for A Better Future”*

Bali, October 31st 2012



UDAYANA UNIVERSITY PRESS
2012

PROCEEDINGS

2nd International Conference on
Sustainable Technology Development

*“Developing Sustainable Technology
for A Better Future”*

Bali, October 31st , 2012

Editors:

Putu Alit Suthanaya, PhD
I Nyoman Satya Kumara, PhD
Ngakan Putu Gede Suardana, PhD
Yenni Ciawi, PhD
Dewi Jayanti, PhD

PROCEEDINGS

2nd International Conference on
Sustainable Technology Development

*“Developing Sustainable Technology
for A Better Future”*

Bali, October 31st , 2012

Scientific Committee:

Prof. I Wayan Redana (Udayana University, Indonesia)
Prof. Sayiqh (President of World Renewable Energy)
Prof. Dai Kue Choi (Chonbuk National University, South Korea)
Prof. Budhima Indraratna (University of Wollongong, Australia)
Prof. Jae Kyoo Lim (Chonbuk National University, South Korea)
Prof. Hu Ruihua (Huanghe University of Science and Technology, China)
Prof. Montasser Dewidar (South Valley University, Egypt)
Prof. Alexander Cuthbert (University of New South Wales, Australia)
Prof. Tjok Gd. Tirta Nindhia (Udayana University, Indonesia)
Prof. I Made Alit Karyawan S. (Udayana University, Indonesia)
Prof. I.A. Giriantari (Udayana University, Indonesia)
Dr. Vu Cong Hoa (Ho Chi Minh City University of Technology, Vietnam)
Dr. G.A.M. Suartika (Udayana University, Indonesia)
Dr. W.Gede Ariastina (Udayana University, Indonesia)
Dr. D.M. Priyantha W. (Udayana University, Indonesia)
Dr. I.K.G. Dharma Putra (Udayana University, Indonesia)

Published by:

Udayana University Press
Kampus Universitas Udayana Denpasar

ISBN: 978-602-7776-06-7



PREFACE

This proceedings compiles all papers presented in the 2nd International Conference on Sustainable Technology Development (ICSTD) held at the Udayana University, Bali on 31st October 2012.

Three plenary presentations were delivered by keynote and invited speakers with international reputations from Japan, Germany, Singapore and Indonesia and a total of 78 papers (oral presentation) compiled in this proceedings, which were presented in the conference from thirteen countries (Indonesia, Japan, Australia, India, Korea, Malaysia, Iran, Egypt, Libya, China, Thailand, Sri Lanka and Bangladesh).

We thank those who involve in the organizing committee for their hardworking. While it was a huge task, it was a privilege for us in editing this proceedings and work together with the referees who reviewed papers.

We hope that the papers contained in this proceeding will prove useful in developing further study.

Editors



FOREWORDS-HEAD OF ORGANIZING COMMITTEE

I would like to sincerely thank to all of the authors who contribute their papers in this proceedings. I would therefore give my high appreciation on all of those effort and dedication.

The conference was held by Faculty of Engineering, Udayana University, in relation to the 50th Udayana University Anniversary and in collaboration with International Institute of Management, Energy and Environmental Management, University of Flensburg, Germany. This conference was aimed to gather scientists, academics, engineers and industries in engineering related areas to discuss and share their expertise and ideas in the field of Sustainable Technology Development. The conference theme “**Developing Sustainable Technology for a Better Future**” has appealed participants presenting their studies on four major fields of **Architecture, Civil Engineering, Mechanical Engineering and Electrical Engineering**. This 2nd ICSTD also focused on development of technology to achieve sustainable city. The conference was financially supported by Engineering Faculty of Udayana University and several sponsors.

I hope this International Conference has created an international networking and collaboration and open up new ideas in maintaining world prosperity in all aspects in sustainable development.

I will use this opportunity to invite you again to join us in The 3rd International Conference on which will be held in the year 2014 in conjunction with the anniversary of Udayana University.

Last but not least, I would like to highly appreciate all of the members of the Organizing Committee for the good teamwork to make the 2nd International Conference on Sustainable Technology Development (ICSTD-Bali 2012) possible and the team of editors for the hard work compiling and editing 78 papers presented in this book.

See you again in Bali at 3rd ICSTD 2014

Putu Alit Suthanaya, ST, MEngSc, PhD



FOREWORDS

RECTOR OF UDAYANA UNIVERSITY

I would like to express my great appreciation to the organizing committee who worked so hard to make the 2nd International Conference on Sustainable Technology Development (ICSTD-Bali 2012) to happen smoothly. This conference was held in conjunction to the 50th Anniversary of Udayana University and being our bi-annual agenda. The main aim of this conference was to respond the problems related to the sustainability in a city, i.e. reduction of the city's use of natural resources and production of wastes, while simultaneously improving its livability.

I was so happy to have you all in Bali which is well known in the world as a favorite tourist destination as well as recently a favorite site for holding International events, such as International Conference. As this conference was designed to gather scientists, engineers, practitioners, and industries in Engineering related disciplines, I expected intense discussion has happened among them so that some brilliant ideas to be used to improve the quality of human life in a city have been formulated and published in this proceeding.

Here, I would also like to acknowledge the National and International invited speakers for their willingness to come miles away to Bali and present their high standard papers. I understand that you all spent much time for this conference, and therefore I must give high appreciation on all of those effort and dedication.

I hope this International Conference was an ideal forum for communication and sharing ideas as well as experience in Engineering-related disciplines in the future. I also hope that this forum served as a forum for promoting advanced technological development with regard to economic growth, environment and social welfare.

Finally, I wished you most successful conference and hope that it provided new ideas and strategies for the application of Engineering in all aspect of our life.

See you again in Bali in 2014

Prof. Dr. dr. I Made Bakta, SpPD.(KHOM)
Rector of Udayana University



TABLE OF CONTENT

PREFACE	<i>i</i>
FOREWORDS-HEAD OF ORGANIZING COMMITTEE	<i>ii</i>
FOREWORDS-RECTOR OF UDAYANA UNIVERSITY	<i>iii</i>

ARCHITECTURE

A 01 (ID 101)	Implementation Concept of Ecological Architecture and Ecotourism in Wonorejo’s Mangrove Ecotourism, Surabaya	A-1
	M.Nelza Mulki Iqbal, Yeremia Azarya Dimpudus	
A 02 (ID 102)	Braga Street: A True Representation of Art Deco	A-9
	Adinya Rossiyana and Team	
A 04 (ID 106)	The role of Government/Governance to sustain Heritage sites in Denpasar	A-16
	Tri Angraini Prajnawrdhi, Alpana Sivam, Sadasivam Karuppannan	
A 05 (ID 112)	Sustainable Development in the Border Region Plan: An anticipation of border areas development to small towns	A-25
	I Dewa Gede Agung Diasana Putra	
A 08 (ID 124)	Learning from Sustainable Landscapes of Death in Bali: Landscape Planning and <i>Tri Hita Karana</i>	A-32
	Ni Made Yudiantini	
A 11 (ID 132)	The Application of The Modular System in The Linear Rise Residential Buildings	A-40
	E. J. Krishna M. O.	
A 12 (ID 133)	Identification of Pabrik Coklat Tjenderawasih as a Potential Conservation Object of Authentic Indonesian <i>Jengki</i> Architecture ...	A-50
	Rizky Darmadi, Adiar Ersti Mardisiwi, Alifia Nurrizky Virrayani	
A 13 (ID 134)	Sustainable Architectural Design of Heinz Frick Home: Coping with the Global Challenges in the Asian Cities	A-57
	Lo Leonardo Agung Mulyono, Devi Calista Silvanus, and Gunawan Tanuwidjaja	
A 18 (ID 145)	Kinds of Decoration of Toraja’s Housing in South Sulawesi Indonesia	A-70
	Hendri Gunawan, Irdham Hirannga	
A 20 (ID 150)	Save the Lost World’s Monumental Dwelling: Is It Necessary?	A-78
	DESTIANA RITANINGSIH, VALENCIA TANDY	
A 21 (ID 151)	Roofs of Building in Indonesia as Architecture Local Identity	A-86
	Ade Amelia, Ana Fitriyani, Annisa Dienfitriah, Maryam Ahmad Assegaf, Vania Dwi Amanda Surya	
A 22 (ID 152)	Interiority: The Real Soul of Architecture	A-94
	Nadita Amalia ^a , Shilta Finella ^b Thaza Theresia Georly, Yohana P. F. Silitonga	
A 23 (ID 155)	Corelation between Gunung Padang and Sundanese Architecture	A-100
	Nadia Absharina Idris, Adinda Putri Maharani, Miftah Tri Nur Fauzi	

A 24 (ID 156)	Indonesian Airports: A Symbol of Local Representation Lee Maw Jia , Veronica Ng Foong Peng	A-108
A 25 (ID 157)	Overwhelming Presence of Foreign Architecture in China Michele Lim Chui Yee Jia, Nor Hayati Hussain	A-116
A 26 (ID 158)	The Application of Traditional Malay Architectural Elements in Modern Museums of Malaysia Lee Shing Yi, Veronica Ng Foong Peng	A-124
A 30 (ID 162)	Concepting The Historical Site ‘Braga’ as The Pleasant Main Pedestrian of Bandung City Dewi Anisa Auriani PRIBADI, Indyrira CHRISYADEWI, Mariyam YASMIN, Sheiren Felicia JAYA	A-133
A 31 (ID 163)	Preserving Agriculture and Fish Breeding in Modern Indonesia Dewi Anisa Auriani PRIBADI, Indyrira CHRISYADEWI, Mariyam YASMIN, Sheiren Felicia JAYA	A-141
A 33 (ID 167)	Dual Faces Architecture of Nias Meridiani Trianandari Winanto Ayu Putri, Angga Kusumah Sukarya, Afina Rahmani, Dadi Satria Ginandjar	A-148
A 34 (ID 168)	Influence Behavior and Environment Towards Dwelling Form and Spaces in Eastern Indonesia. Case Study : Fak-fak, Papua Andreas D. Handoyo, Gabriella Sabatini Wijaya, Irma Paramitha, Steven Ardianto, Samuel T. Handoyo	A-156
A 35 (ID 169)	The Combination Culture of Architectural Features. Case Study: Residential House and Buddhist Temple in Kampung Karangturi, Lasem..... Lola Charista a, Helen Primalia, Carissa, Augusta Diana E, Valeria Theresia W	A-168
A 36 (ID 170)	Application of Green Building Concept in Indonesia Forest JIEPRANG, Yoedhistira ANDRI PUTRA, Edu ISKANDAR, Reo FAROGA, Randy PISON	A-178
A 37 (ID 171)	Acculturation In Kampung Kulitan Semarang CERIA Ginting, FAIZAL Rahman, JIMMY Andreas, JULIUS Richard, OCTAVIA Maryanche, VIVIN Rosalyn	A-184
A 40 (ID 174)	The Heritage Zoning Determination Criteria of Cimahi’s Town Square and Its Surroundings Ega KARTIKAWATI, Astrid Austranti YUWONO, Pia Praptidita SURATMAN, Rianto PRABOWO, Wahyu Edi SUWARNO	A-192
A 41 (ID 175)	The Landscape of Kampung Naga Developed by the Village Culture..... Abdul Said Ahtar ^a , Diba Aththaariq, Iqbal Adam, Oka Kartika, Steffie Prilianty, Prathito Andy Wisambodhi, Tera Wednes Oktireva Harsa	A-200
A 42 (ID 176)	For the Sake of Past, in Bandung We Trust: The Development of Braga and ABC Street Annisa Kusumadewi A, Bellarida Febriyanti, Clara Emmanuela, Erna Rosmawati, Heny Ira Mustika, Meskhi Malida D, Prysha Novika, Rahajeng Sekar Putri	A-208
A 43 (ID 177)	Culture Control in Toraja’s Traditional Architecture Development .. Amanda Erika Isdyati, Arina Resyta Rahma, Aszafaika Ladidinanda, Dewanti Ashariani, Ivan Winanto, Reina Rivenska Dissa, Sayyida Lathifa Tiara Rossyda Sahara	A-215
A 44 (ID 178)	Renarrativization of Bengal Jatra: through the Eye of Architecture... ASHRAFI, Farhin ^a , DIPTA, Talha Mahmud ^b , AHMED, Tahsin ^c , ISLAM, Md. Tauhidul	A-221
A 45	Topography Restoration of Historic City.....	A-229

(ID 180)	HAN Dong soo, LEE Sung ho	
A 46	Persistency of Architecture in Traditional Village of Kuta, West Java	A-238
ID190	Lucky Fachrurrozi, Cindy Novita, and Team	
A 47	Sustainable Innovative Design Practice in India.....	A-247
(ID 121)	Kishor P.REWATKAR, Priyanka K.REWATKAR,	
A48	Local Wisdom in Urban Protected Areas: Case of Collective	
(ID 137)	Consciousness in Caring for Mangrove Forest in Denpasar Metropolitan Area, Bali Province, Indonesia.....	A-258
	Hilwati Hindersah	
A 49	Local Wisdom of Kasepuhan Ciptagelar.....	A-266
(ID 191)	Emilia Rahmawati, Fachrurrozi Ramadhan, Raden Muhamad Lutfi	
A 50	Tropical Architecture: Discover The Characteristic Of Indonesian	
(ID 192)	Vernacular Architecture.....	A-275
	Dian Eka Pertiwi, Mustofa	
A 51	A Method for Discovering Regional Resources with Five Senses....	A-283
(ID 193)	Manami Fujiwara, Kita Yusuke, Maki Onishi	
A 53	Sri Lankan Vernacular Architecture	A-293
(ID 198)	L.M RATHNAYAKE ^a , P.P.G.D.S.KULATHUNGA ^b , K. RATHNAHARAN ^c , H.P JAYAKODY ^d	
A 55	Traditional Architecture Of Nias : It's Developing For The New	
(ID 202)	Buildings In The Present Era.....	A-301
	Benonius Servistan Bidaya, Susanti Muvana Nainggolan	
A 56	Understanding and re-incorporating lessons of vernacular	
(ID 201)	architecture in contemporary Malaysian dwellings.....	A-309
	Amira Nabila bt Raduwan, Chan Huey Hoong, Mohamad Sadeeq bin Mohamad Said, Ili Syahirah bt Zainal Abidin, Yap Chee Chaw	
A 57	A Method for Discovering Regional Resources with Five Senses	
(ID 203)	A Case Study in Kyoto Arashiyama.....	A-320
	Manami Fujiwara, Kita Yusuke, Maki Onishi	
A 58	For whom we build and preserve? Human-based cultural approach towards	
(ID 205)	sustainable architectural design and heritage.....	A-330
	LAM Sai Chin	
A 59	Blue House: Preservation of vernacular architecture and living habitat.....	
(ID 206)	WONG Sze Kan	A-339
A 60	Adaptive Re-Use: The Conservation of a Building and Restoration of a	
(ID 208)	Culture.....	A-347
	H.E MADDEWITHANA ^a , T.S HEWAGE ^b , M.S.N De ZOYSA ^c	
A 61	Using Plastered Bamboo for Housing as the Innovative Eco-Construction in	
(ID 209)	Asia.....	A-356
	Patriot Negri ^a , Alicia Tiffany ^b , Decia Widyasinta ^c , Henry Hadathia ^d , Karina Wiriadidjaja ^e	

A 62 (ID 210)	Student investigation in urban space; Urbanization, regional identity and Architecture. Bandara V. Y. J ¹ , Abeykoon A. J. M. P. A ² , Gunawardhana A. W. D. J ³	A-365
A 63 (ID 211)	STAGE HOUSE AS GORONTALO'S VERNACULAR ARCHITECTURE... Inda Putri Julianty, Wadira Syabilla Utami	A-375
A 64 (ID 212)	Introduction to Lasem Architecture, Java's Forgotten Little China (<i>Le Petite Chinois</i>) Luke Theodorus, Auri Evan, Aglis Dhamar	A-383

CIVIL ENGINEERING

C 01 (ID 105)	Studies on Transport-Modes in the Region of Southern Bali I Wayan Suweda ^a , Achmad Wicaksono ^b , Indrasurya B. Mochtar ^c	C-1
C 06 (ID 117)	Characteristics of Sand Sheet Asphalt Mixture Utilizing Waste Aggregates I Nyoman Arya THANAYA, Putu Preantjaya WINAYA , Putu Anggi WEDAYANTI	C-10
C 10 (ID 127)	The Effect Of Rainfall Characteristic Change For The Result Of Global Climate Change and The Impact To Flood Phenomenon I Gusti Bagus Sila Dharma, I Putu Gustave Suryantara Pariartha	C-18
C 12 (ID 138)	Islamic Bank Participation in Indonesia Infrastructure Provision Ayomi Dita Rarasati, Eric Too, Bambang Trigunarsyah, Fiona Cheung	C-24
C 13 (ID 139)	Identification of Factors of Road Safety Problems in Indonesia and Recommended Solutions to Improve Road Safety A. Caroline SUTANDI, Efraim Mtimanta SURBAKTI	C-33
C 14 (ID 146)	Concrete Wall Panel From Styrofoam Waste with Wiremesh Reinforcement Andi Prasetyo Wibowo	C-40
C 15 (ID 153)	Numerical Modeling of Reinforced Concrete Beams Repaired with Polymer-Modified Mortars Luthfi M Mauludin, Fransesca da Porto	C-48
C16 ID 181	The addition of <i>Canggahwang</i> and <i>Sunduk</i> to the <i>Saka</i> of Balinese Traditional Houses Increases the Residents' Safety Arising from Earthquake Load..... I Nyoman Sutarja	C-55
C17 (ID 182)	Geometry Non-Linearity and Performance Base Design Procedure Relevant to Predict the Seismic Performance of Low-Rise Building and a Structures in a Developing Country (Indonesia)..... G.A. SUSILA ^a , P. MANDAL ^b & T. SWAILES	C-61
C18 (ID	RESTRUCTURING PUBLIC TRANSPORT NETWORK FOR KRENENG STATION IN DENPASAR CITY Putu Alit Suthanaya ^a , Ratih Pradnyawati	C-70

C19 (ID213)	RECLAMATION ENVIRONMENT VISION AS AN ALTERNATIVE DEVELOPMENT FOR PORT FACILITY: Literature Review Case application I Nyoman Budiarta R.M	C-78
----------------	---	------

MECHANICAL ENGINEERING

M 01 (ID 104)	Fuzzy-PID Ratio Controller of An Electro-Mechanical Continuously Variable Transmission for Automotive Application..... B. Supriyo, K.B. Tawi, H. Jamaluddin, H. Nasution, A. Budianto, M.S. Che Kob and S. Ariyono	M-1
M 02 (ID 109)	The variation of blade number and the rotational operation in the various wind occurrence distributions of the clean and renewable wind power machine Ridway Balaka, Aditya Rachman, Yuni Aryani Koedoes	M-12
M 03 (ID 110)	Prospect of Iran Natural Gas Export Projects Hedayat Omidvar	M-21
M 05 (ID 120)	Performance of Diamond Cutting Tool in the Turning Process of Stainless Steel, Copper and Aluminium Ida Bagus Puspa Indra, Tjokorda Gde Tirta Nindhia, I Nyoman Gede Antara	M-31
M 06 (ID 123)	Time Study Analysis of Food Services Using Man Machine Mapping I Wayan Sukania, Oktaviangel, Julita	M-42
M 07 (ID 125)	Comparison Vickers Hardness of Welding Alumunium-MG 5083 with Welded for Metal Inert Gas (MIG) and Tungsten Inert Gas (TIG) I Gusti Ngurah Ardana, Tjokorda Gde Tirta Nindhia, I Made Widiyarta	M-48
M 10 (ID 130)	Performance of Repetitive type of Biogas Desulfurizer Made from Steel Chips Waste..... Tjokorda Gde Tirta NINDHIA, Komang Metty Trisna NEGARA, I Made SUCIPTA, I Wayan SURATA, I Ketut Adi ATMIKA, Dewa Ngakan Ketut Putra NEGARA	M-63
M 12 (ID 142)	A Green Manufacturing Process For Small Vertical Axis Wind Turbine blade..... Rui-Hua Hu, Ai-Yun Jiang, Zhi-Guo Ma, Cai-Xia Fan, Jing-ChaoZou	M-70
M 13 (ID 143)	Study Physical and Mechanical Properties of Vegetal Material on composite structures..... Abdalla Abdal-hay, Ngakan Putu Gede Suardana, Jong-Woo Kim, Cheol In Kim, Jae Kyoo Lim	M-76
M 16 (ID 154)	CFD as Aiding Tool to Predict Airflow and Thermal Performance of Buildings. Case Study: Airflow Pattern and Thermal Performance in Classroom, University of Atmajaya J. Ade Prasetya S.	M-83

M 17 (ID 179)	Effect of chemical treatments on the tensile strength and flammability of paper mulberry fiber reinforced PLA composites Jian-Guo Cui, NPG. Suardana, Hyun-Chel Kim, Jae-Kyoo Lim	M-92
M 18 ID 187	Line Assembling Investigation of Three Wheels Bicycle Using Time Measurement Method at Pt X..... I Wayan Sukania, Iwan Susanto	M-101
M 19 (ID 188)	Tensile And Impact Strength of Bamboo Fiber Reinforced Epoxy Composites As Alternative Materials For Above Knee Prosthetic Socket..... Agustinus Purna Irawan, I Wayan Sukania	M-109
M 20 (ID189)	Experimental Study of Dynamic Vibration on Prototype Auditory Membrane Made of PVDF..... Harto Tanujaya, Susilodinata, Adianto, Hirofumi Shintaku, and Satoyuki Kawano	M-116
M 21 (ID196)	Simulation On Characteristic Of Fluidization Phenomena Using Waste Particles..... I Nyoman Suprpta Winaya, I Nyoman Gede Sujana, I Made Agus Putrawan	M-121
M 22 (ID202)	Quality Improvement of Dried Seaweed by Using Cabinet Dryer..... I Wayan Surata ^a , Tjokorda Gde Tirta Nindhia ^b , I Ketut Adi Atmika ^c	M-129

ELECTRICAL ENGINEERING

E 01 (ID122)	The Role of University in Improving the Quality Sustainable Technological Development (IQSTD)..... Yuda Bakti Zainal, Een Taryana, Rohani Jahja Widodo	E-1
E 02 (ID165)	Development of Mobile Application for Theater Booking System Andik Setyono , Md. Jahangir Alam, and Amit Roy	E-9
E 03 (ID166)	Study and Design of the Video for Mobile Communication Andik Setyono	E-16
E 04 (ID194)	APPLICATION OF HYBRID ACTIVE POWER FILTER TO REDUCE LOSSES DUE TO HARMONICS DISTORTION: A CASE STUDY IN A CITY HOTEL I M. E. Purwa Antaka, W. G. Ariastina, I N. S. Kumara, and R. S. Hartati	E-24
E 05 (ID195)	Special Pattern Development for Feature Extraction In Balinese Print Character Recognition System Base on Localized Arc Pattern Method AA. K. Oka Sudana; Ni Kadek Ayu Wirdiani; Gusti Agung Ayu Putri	E-32
E06 (ID204)	Mixed Reality in Tele-operation Using Virtual Environment Second Life I Nyoman Piarsa, Putu Wiryadi Sastraningrat	E-41

M 13 (ID 143)

Study Physical and Mechanical Properties of Vegetal Material on composite structures

Abdalla Abdal-hay^{a,b}, Ngakan Putu Gede Suardana^c, Jong-Woo Kim^b, Cheol In Kim^b, Jae Kyoo Lim^{b,*}

^a*Department of Mechanical Design composite materials strength and fracture mechanics, Chonbuk National University
E-mail : abda_55@jbnu.ac.kr*

^b*Department of Mechanical Design, Advanced Wind Power System Research Institute, Chonbuk National University, Jeonju, 561-756, Republic of Korea*

^c*Mechanical Engineering Department, Udayana University, Jimbaran, Badung, Bali, Indonesia
npgsuardana@yahoo.com*

^{*}*E-mail : jklim@jbnu.ac.kr; Tel: +82-63-270-2321 Fax: +82-63-270-4439*

ABSTRACT: This paper presents study and an experimental on the vegetal particles (date palm seed particles/DPSp) and applies it as composites material reinforced unsaturated polyester (USP). The experimental of particles were investigated with and without alkali-treatment process. They physically investigated by using FT-IR and TGA analysis. The composite samples indicate higher thermal stability than pristine polymer. The mechanical properties of the composite samples were investigated by compression, hardness and flexural tests. The mechanical properties tests of the composites revealed that addition of the DPSp has distinct impacts especially at low content. Overall, addition of the proposed DPS particles may be opens a new avenue to exploit the utilized natural cheap material to produce a green composite.

Key Words: *A, Natural materials B, Date palm fiber C, Green composite D, Thermosetting polymer E, Mechanical properties*

1. INTRODUCTION AND CHALLENGES

The natural plant materials has unique characteristics and many advantages such as, abundance, biodegradability, low density, derived from a renewable resource, low energy inputs in their manufacture and easily to recycle (Sangthong et al., 2009). Furthermore, due to simple manufacturing technique natural plant materials have found many applications in infrastructure, and automotive packing sectors. Moreover, the use of vegetal material as reinforced polymer composites has been the center of attention of the research field during the last years.

The Agricultural Research Service of USDA has the responsibility to develop and expand the use of sustainable, environmentally friendly biobased products, for a variety of applications (Abdal-hay et al., 2012b). The date palm tree is widely cultivated in Middle East, United States and North Africa countries. There are more than 100 million date palm trees in the world and it can grow for more than 100 years. Although the seed presents 10% of fruit weight, these seeds can be considered as waste as there are not industrial needs, and so they are costless and start to form a pollution problem in some regions. According to that, the recycling waste natural plant to produce useful products would clearly to be benefit. In

addition, cellulosic natural material and even their waste, generated as a by-product of the production, and their use is likely to find high-value outlets. Williams and Reed (Williams and Reed, 2004) have successfully investigated vegetal waste materials to produce activated carbons by chemical activation and pyrolysis method. As a result, natural plants until now are renewing for using as a composite materials reinforced polymers

The use particles as reinforcement can avoid the limitations of natural fiber such as, delamination, fiber pull out through the matrix and the presence of hydroxyl and other polar groups in the natural fibers, would lead to the weak interfacial bonding between fibers and the hydrophobic polymers (Abdal-hay et al., 2012b). Subsequently, many chemical modifications methods are required to improve the adhesion between fiber and matrix, the chemical modifications employed are synthetic and toxic.

The aim of the present study is to investigate about the DPS as a waste plant material. As well as, applying untreated micro-particles as reinforcement unsaturated polyester (USP), physical properties (thermal analysis and FTIR spectroscopy) and mechanical properties of the composites at different particles weight fractions have been investigated.

2. MATERIALS AND METHODOLOGY

2.1 MATERIALS AND PREPARATION

The extraction and the preparation of the date palm particle materials as well as the alkaline chemical treatment of the this material have been given in details in our previous publications (Abdal-Hay et al., 2012a; Abdal-hay et al., 2012b).

2.3 CHARACTERIZATION

Infrared spectra of powder samples (4000-400 cm^{-1}) were recorded using a Fourier transform infrared (FT-IR) spectrometer (Perkin Elmer). A TGAQ50 instrument was used for thermogravimetric analyses (TGA) of the composites samples from room temperature to 600 $^{\circ}\text{C}$ at a heating rate 10 $^{\circ}\text{C}/\text{min}$ under nitrogen gas flowing at 60 ml/ min. About 20-30 mg of sample was used in each test.

The compression strength measurement of the composites sample was conducted with a mechanical tester (Computerized Instron Universal Testing Instrument model 4206). The testing was done in a standard laboratory atmosphere. The samples were reported by the tests were conducted at across-head speed of 1 mm/min. The two surfaces of cylindrical were machined by using SiC paper for successive grade, 420, 1000, and 1200; for each sample test. The compression strength, CS, was evaluated using the load–displacement curve with the peak load from the curve and the initial cross-sectional area of the sample. The composite samples Underwent standard compression tests until the next constant maximum stress was reached.

Three point bending test was carried out by the same universal testing machine with a cross head speed 0.5 mm/min and span length 18 mm. where, The geometry of specimen was cut into 23 mm X 4 mm X 3 mm for testing.

Hardness indentation test was carried out by Rockwell tester machine and HRM model was

used to evaluate the indentation value for every composites sample. Number of indentations for each composite sample was 15 times.

3. RESULTS AND DISCUSSION

3.1. SPECTROSCOPIC CHARACTERIZATION

The major component in the plants is cellulose, it has been reported that the mechanical properties of the natural plant are related to their cellulose type and content (Morán et al., 2008). FTIR spectrum of the untreated and treated powder is presented in Fig. 1, in the range of 4000 to 400 cm^{-1} . The structure of the DPSp changed due to the alkali effect, the spectrum shows many absorption bands (weak and broad). The region 3500-2500 cm^{-1} in the untreated particles is mainly related to OH groups stretching vibration, also it indicates the adsorbed water. This broad peak could not be seen in case of the alkali treatment which indicates that the hydroxyl groups and the remaining adsorbed water were removed. The peaks located around 2927 and 2854 cm^{-1} are attributed to CH and CH_2 groups, respectively (Abdal-hay et al., 2012b), which became weak and relatively abroad. At the same time some peaks in the 2860–1830 cm^{-1} disappear after the chemical treatment, the peak around 1053 cm^{-1} for the cellulose backbone is assigned to C-OH stretching vibration. These due to sodium hydroxide treatment is known to extract ashes, fats, and residual impurities from the surface of the natural plant and can reduce the OH group concentration. As well as the Alkali treatment can be attributed to a high impact effective on the surface. The same behavior of FTIR pattern with alkali treatment was reported by John et al with zein treated kenaf fiber (John et al., 2010). It can be concluded from the FTIR results, DPS is an amenable to chemical treatment

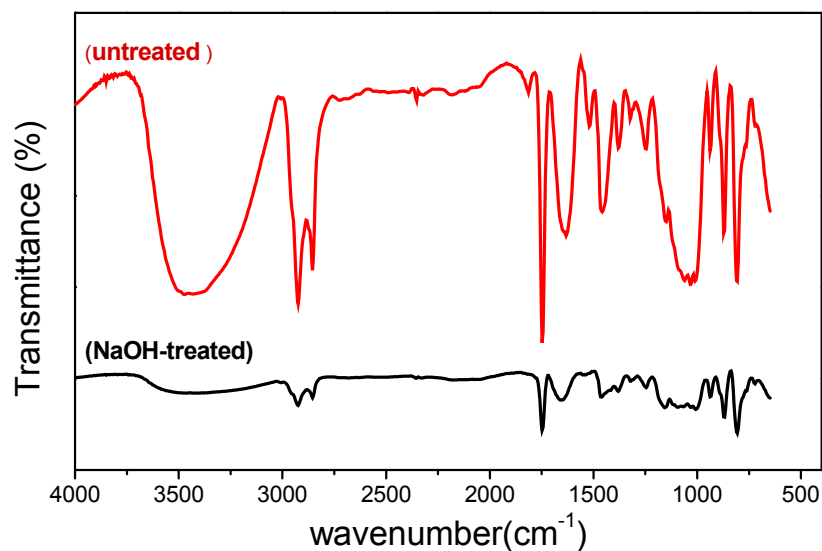


Fig.1. FT-IR spectra of untreated and alkali-treated powder

3.2. THERMAL PROPERTIES

Fig.2 shows the thermal characteristics (TGA) of the composites at varying particle weight fraction. The TGA of the composites at different particles weight fraction show two-step decomposition patterns, these occur at temperatures of around 257- 315 C, and 315-450 C.

This related to the cellulose degradation, and temperature around of 400-450 °C is probably due to the inorganic substances exists in the seed. Overall, study the thermal properties of the proposed composite indicates that the proposed reinforcing particles have a distinct influence at low content. In addition, at high particles content, the particles successfully protect the polymer matrix from the thermal degradation upon heating (as shown in Fig. 2). Subsequently, the weight percentages of the residues are 1.84, 4.27, 7.2, and 13.045 % for 0, 10, 20, and 40 wt%, respectively. The increase of residue could be explained as a higher thermal stability of composites by adhesion between the DPSp reinforcements and the matrix. Accordingly, as it was expected that the date seed particles are good candidates to reinforce the thermosetting as well as thermoplastic polymer matrices. In other words, the proposed particles could enhance the thermal degradation behavior of the polymers because the exothermic reactions and the melting points of most of the thermosetting and thermoplastic polymers are relatively lower than the starting degradation temperature of the DPSp.

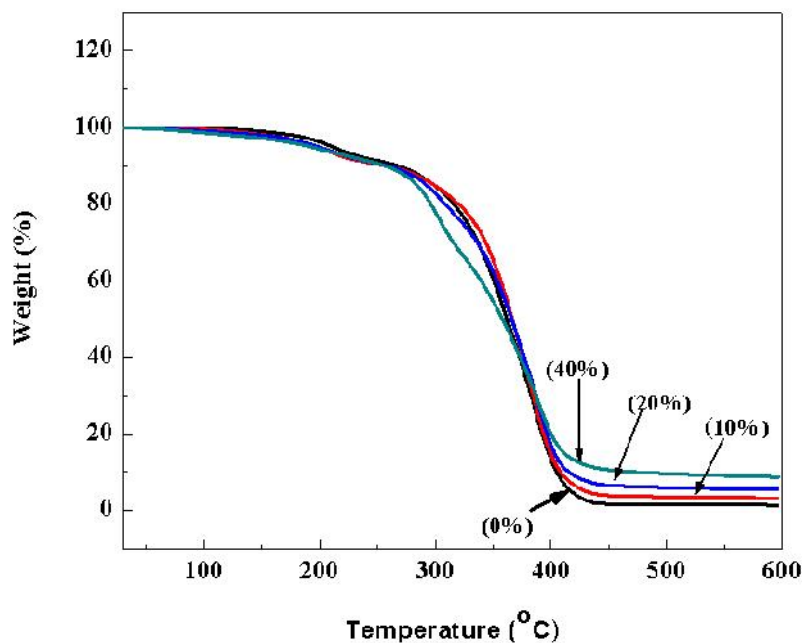


Fig.2. Thermal analysis (TGA) of the USP composite at different weight fraction of the particles

3.3. MECHANICAL PROPERTIES

The importance of compression as a load application mode is increasing. For instance, assemblies of the electric conductors and insulators held together by fastening devices might be subjected to compression loading. As well as, components of a flying airplane are also subjected to compressive forces. Hardness properties are widely used to indicate the adhesion bonding between the matrices (Park et al., 2010; Sangthong et al., 2009). Fig. 3A shows the compression strength and hardness properties of the composites at varying particle weight fraction of the virgin DSPs. As shown in the figure, the composite having 10 wt% DPSp has the maximum compression strength and hardness; however increase the particles content has a negative influence. The observed increases in the compression strength and the hardness for the 10 wt% composite are around 180 MPa and 118 HRM respectively compared with 40 wt% which are around 119 MPa and 90 HRM. Unfortunately, beyond the optimum DPSp weight percentage (i.e. 10 wt%) more addition has negative impact on the hardness as the later

decreases with increasing the DPSp content. Fig.4a and b show the scanning electron micrographs of the fracture surface of composites at particle weight fraction 10% and 40%. It was clearly observed that at 10 wt% high interfacial bonding between the DPSp and USP matrix. However, poor adhesion at 40 wt%, for this reason, there is a number of closed pores entrapped in the sample as well as the fracture surface looks like brittle fracture at 40 wt% of DPSp as shown in inset figure7 for the stress displacement curve and Fig.4b.

Flexure properties are believed to give more reliable results for brittle materials than tensile strength, because it is a combination of tensile and compressive strengths. The flexure strength of the USP reinforced by DPSp as novel natural plant composite materials at different particle weight fractions is illustrated in Fig.3B. As illustrated in the figure, the highest flexure strength was found at 10 wt% of particle reinforcement, the mean values of the flexure at this percentage were around 74.63 MPa. The behavior of the flexure strength is similar to hardness properties which were discussed in a previous section.

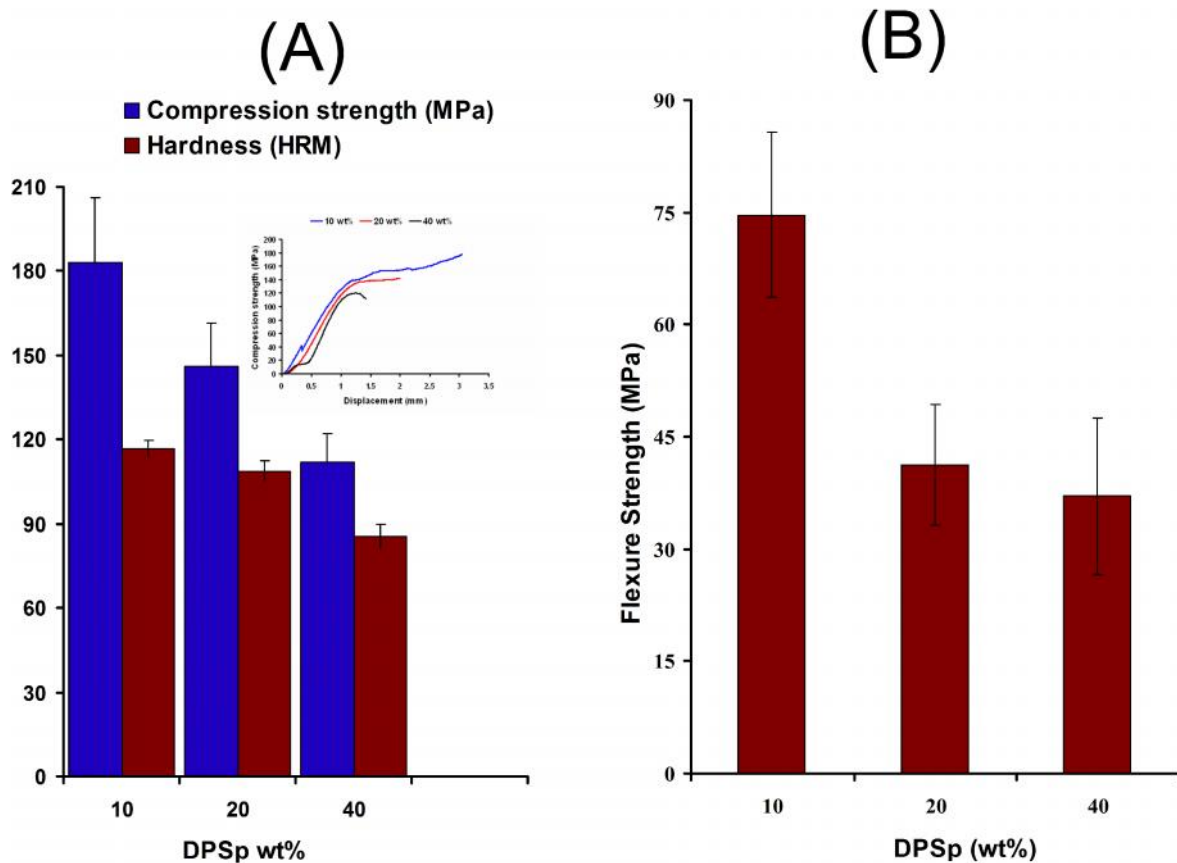


Fig.3. (A) Compression strength and hardness properties of the composites at different weight fraction of the particle (inset figure presents Stress-Displacement curve for selected samples) and (B) Effect of the DPSp weight percentage on the flexure strength

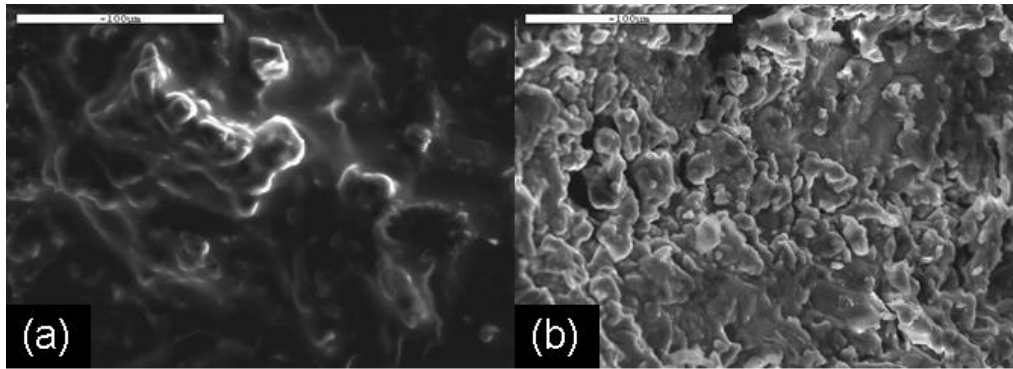


Fig.4. SEM micrographs of the compression fracture surface of the DPSp/USP composites at different particles content: (a) 10 wt% and (b) 40 wt%. Panel

4. CONCLUSION

After drying the date palm seeds, they can be grinded to micro-scale. Alkali treatment of the obtained powder using 6% NaOH aqueous solution leads to remove the fats, ashes and other artificial impurities present in the surface which increases the porosity and decreases the actual density of the treated particles compared with the virgin ones. The virgin particles strongly have higher mechanical properties when they are used in small weight fractions (i.e. 10 wt% particles) than high loading particles. Considering the costless of the proposed reinforcing agent, the proposed composites in this study might have good polymer-based industrial applications. Overall, this study might open new avenue for utilizing the proposed palm seeds particles to produce activated carbons or used in removing heavy metals from soil polluted.

ACKNOWLEDGMENTS

This research was supported by the research funds of Chonbuk National University in 2010. In addition, the Ministry of Education, Science Technology (MEST) and the National Research Foundation of Korea (NRF) through the Human Resource Training Project, as well as Eco-friendly manufacturing technology and automation for mulberry pulp and yarns have financially supported it for Regional Innovation.

REFERENCES

- Abdal-Hay, A., Jung, D.Y., Lee, K.I., Abdel-Jaber, G., Lim, J.K., (2012a) Study on Water Absorption and Impact Properties of Vegetal Composites Material: Composite Structures. *Advanced Materials Research* 530, 34-39.
- Abdal-hay, A., Suardana, N.P.G., Jung, D.Y., Choi, K.S., Lim, J.K., (2012b) Effect of diameters and alkali treatment on the tensile properties of date palm fiber reinforced epoxy composites. *International Journal of Precision Engineering and Manufacturing* 13, 1199-1206.
- John, M.J., Bellmann, C., Anandjiwala, R.D., (2010) Kenaf–polypropylene composites: Effect of amphiphilic coupling agent on surface properties of fibres and composites.

- Carbohydrate Polymers 82, 549-554.
- Morán, J., Alvarez, V., Cyras, V., Vázquez, A., (2008) Extraction of cellulose and preparation of nanocellulose from sisal fibers. *Cellulose* 15, 149-159.
- Park, N.-R., Ko, I.-Y., Doh, J.-M., Kong, W.-Y., Yoon, J.-K., Shon, I.-J., (2010) Rapid consolidation of nanocrystalline 3Ni–Al₂O₃ composite from mechanically synthesized powders by high frequency induction heated sintering. *Materials Characterization* 61, 277-282.
- Sangthong, S., Pongprayoon, T., Yanumet, N., (2009) Mechanical property improvement of unsaturated polyester composite reinforced with admicellar-treated sisal fibers. *Composites Part A: Applied Science and Manufacturing* 40, 687-694.
- Williams, P.T., Reed, A.R., (2004) High grade activated carbon matting derived from the chemical activation and pyrolysis of natural fibre textile waste. *Journal of Analytical and Applied Pyrolysis* 71, 971-986.