

ISBN :



CONFERENCE PROGRAMS AND ABSTRACT

**ADVANCING SUSTAINABLE SCIENCE AND TECHNOLOGY
THROUGH EFFECTIVE COLLABORATION**

OCTOBER 20-21, 2021

**Palembang, Province of South Sumatera
Indonesia**

Organized By :



FOREWORD FROM GENERAL CHAIR 5th FIRST 2021 INTERNATIONAL CONFERENCE



Assalamu'alaikum wr wb,

Alhamdulillahirrobbil 'alamin, Thank to the God, almighty, due to His bless and love, we are granted good health and opportunity so that we can meet here in the event of the 5th FIRST and the 3rd SNAPTEKMAS 2021.

The honorable keynote speakers of the 5th FIRST and the 3rd SNAPTEKMAS 2021

Dra. Nana Yuliana, MA., Ph.D., as The Indonesian LBBP Ambassador for the Republic of Cuba, concurrently with the Commonwealth of the Bahamas, Jamaica, the Dominican Republic and Haiti

Prof. Ramaraj Boopathy. from U Alcee Fortier Distinguished Service Professor of Biological Sciences At the Nicholls State University, USA

Dr. Ing. Ahmad Taqwa, the Director of State Polytechnic of Sriwijaya.

The honourable keynote speakers, distinguished guests, all participants, ladies and gentlemen,

For the beginning of my speech, let me welcome all of you with my great warm hug. It is a great honor for me that you choose the 5th FIRST and the 3rd SNAPTEKMAS 2021 as your conference. I am so proud that the authors still become enthusiastic to develop the knowledge although in this pandemic situation. Let us still work hard to support the development of the world through the research, science, and technology in many parts of the knowledge, as what has been purposed by the FIRST conference itself.

In this occasion, I would like proudly to inform you that the 5th FIRST and the 3rd SNAPTEKMAS 2021 as the forum to share knowledge, to search, to find, and to enlarge the link with other industries and universities has attracted so many authors from abroad, such as from: Politeknik Tun Syed Nasir Syed Ismail; MARA University; Politeknik Mukah Sarawak; University Sultan Zainal Abidin, Terengganu, Malaysia; Politeknik Melaka (PMK) Malaysia; Iloilo Science and Technology University (ISAT-U) Philipina; Politeknik Kota Kinabalu; Universiti Teknologi Malaysia; The National University of Malaysia; National Chin-Yi University of Technology (NCUT); Accounting Research Institute UiTM-Malaysia; Management and Science University Malaysia; AlBaha University, KSA, Saudi Arabia; Politeknik Melaka (PMK), Malaysia; Kuantan Community College, Pahang, Malaysia; Universiti Brunei Darussalam; and Ferdowsi University of Mashhad, Iran.

Welcome to all of the researchers that become the collaborators in our research and community service. It is our great honour to have you as our collaborators and participants in the 5th FIRST and the 3rd SNAPTEKMAS 2021.

The honourable keynote speakers, distinguished guests, all participants, ladies and gentlemen,

In this chance, I would like to say thank you very much to the Director of State Polytechnic of Sriwijaya for his full support in the development of the Research and Service Community programs. Due to his hard work and his belief to all of the committee so that this event can be held.

In this occasion, I also would like to convey my big thank to all of the keynote speakers, invited guests, all the participants, all reviewers, and all committee of the 5th FIRST and the 3rd SNAPTEKMAS 2021. Without you all, this event will be nothing. May Allah SWT gives His reward for your sincerity. As the time goes by, it is hoped that our cooperation and coordination in the FIRST and SNAPTEKMAS can be maintained and improved. I hope that you can enjoy this conference and can get a big benefit from this event. I also wish that we can meet again in the forthcoming FISRT ad SNAPTEKMAS

Wassalamu'alaikumwaraahmatullahi wabarakatuh

FOREWORD FROM DIRECTOR OF STATE POLYTECHNIC OF SRIWIJAYA



The honorable, FIRST 2021 and SNAPTEKMAS 2021 keynote speakers,

Dra. Nana Yuliana, MA., Ph.D., as The Indonesian LBBP Ambassador for the Republic of Cuba, accredited to the Bahamas, Republic of Dominican, Republic of Haiti and Jamaica

Prof. Ramaraj Boopathy., from U Alcee Fortier Distinguished Service Professor of biological sciences at the Nicholls State University, USA

Dr. Ing. Ahmad Taqwa, MT., as Director of Politeknik Negeri Sriwijaya

Assalamualaikum wr wb,

Let us extend our gratitude to Allah SWT, the most gracious, the most merciful. Due to His bless, we can gather here, at the Opening Ceremony of the FIRST 2021 and SNAPTEKMAS 2021

First of all, Please let me deliver my warm welcome to all keynote speakers and all participant of FIRST 2021 and SNAPTEKMAS 2021. It is my great pleasure to meet and see you in this event.

Although, there are so many obstacles that should be faced in the pandemic situation, however, as young generation, we should be optimistic, stay strong and be active in searching and finding the solution. The FIRST 2021 and SNAPTEKMAS 2021 as the DIES of State Polytechnic of Sriwijaya annual event will become one of the media to support those activities. The researchers could share knowledge, find partners, and enlarge the collaboration through this event.

Based on the change in the model of the teaching learning activity that focuses on the MERDEKA BELAJAR, State Polytechnic of Sriwijaya has a big desire in getting acceleration in the internationalization of the institution. One of them by improving the overseas and industrial collaboration, especially in joint research and joint publication. In the beginning of 2021, the research and community service unit in Politeknik Negeri Sriwijaya has launched new schemes of research and community service, namely the Overseas Collaboration Research and Overseas Collaboration Community Service. Thanks to God, those schemes have attracted researchers not only from Asia but also several other countries outside Asia, such as: research and community service collaboration with Al Baha University from Saudi Arabia, with Ferdowsi University of Mashhad from Iran, and with Princess Sumaya University of Technology from Jordan, as well as several other foreign universities.

In this occasion, I also would like to welcome all the researchers that become the collaborators in our new scheme of research and community service. It is our great honour to have you as our collaborators.

The honourable participants,

At this time, State Polytechnic of Sriwijaya has held 5 times of FIRST. FIRST publications from previous conferences have been successfully indexed not only in SCOPUS, but also in WOS. This 5th FIRST seminar will be conjugated with the 3rd National Seminar on Community Service SNAPTEKMAS. (National seminar of applied technology for public). All of these are the efforts to improve the quality of Polsri lecturers which significantly have a positive effect on the learning process of Polsri students.

Before ending my speech, I would like to congratulate the participants of The FIRST 2021 and SNAPTEKMAS 2021. May the noble efforts, support, and cooperation of researchers in this conference will continue. Special thanks to the organizer and co-organizer committee of The FIRST 2021 and SNAPTEKMAS 2021 for the hard work and the commitment in realizing this conference. Do maintain the spirit of working in a team and continue to unite in order to display a culture of excellence in the eyes of the country and the world.

With Bismillahirrahmanirrahim, I officiate The FIRST 2021 and SNAPTEKMAS 2021.
Wassalamu'alaikum warrahmatullahi Wabarakatu

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KEYNOTE SPEAKER



Dra. Nana Yuliana, MA., Ph.D.

The Indonesian LBBP Ambassador for the Republic of Cuba, concurrently with the Commonwealth of the Bahamas, Jamaica, the Dominican Republic and Haiti

Her Excellency Ambassador Nana Yuliana, Ph.D arrived in Havana, Cuba on December, 23rd, 2020 to serve her duties as the Ambassador Extraordinary and Plenipotentiary of the Republic of Indonesia to Republic of Cuba, Commonwealth of Bahamas, Dominican Republic, Republic of Haiti and Jamaica. She was appointed by the President of the Republic of Indonesia on October 19th, 2020. Prior to her position as Ambassador Extraordinary and Plenipotentiary, she was Consul General of the Republic of Indonesia in Houston, Texas, United States of America from 2017 –2020, after she was the Director of Mid-Career Diplomatic School at the Ministry of Foreign Affairs of Indonesia from 2014 – 2017. Her first diplomatic assignment was as First Secretary of Political Affairs at the Embassy of Indonesia in Manila from 2001-2005. From 2008 to 2012, she was the Counsellor of Economic Affairs of the Embassy of Indonesia in Bangkok and Permanent Representative of Indonesia to the United Nations Economic and Social Commission for Asia and Pacific (UNESCAP). She attended several meetings related to Millennium Development Goals (MDGs) or Sustainable Development Goals (SDGs) issues. Her bachelor's degree was English Education from Institute of Teacher's Training in Jakarta, then she pursued her Master Degree in Applied Linguistics for Macquarie University in Sydney, Australia and also International Relations from University of Indonesia in Jakarta, Indonesia. She completed her Doctoral Degree in Development Studies from the University of Santo Tomas, Manila, Philippines in 2006. While serving as a diplomat since 1995, her passion in teaching and learning encourages her as well to share her knowledge and teaches at the University in Jakarta, Indonesia. During her tenure as Consul General, she was very active in promoting Trade, Tourism, Inbound and Outbound Investments and very keen to engage with Universities for cooperation in human capital development.

KEYNOTE SPEAKER



Prof. Ramaraj Boopathy

Alcee Fortier Distinguished Service Professor of biological sciences
at the Nicholls State University, USA

Fulbright Scholar Fulbright Senior Specialist World Class Professor-Government of Indonesia. Honorary Visiting Professor, ITB, Indonesia Alcee Fortier Distinguished Service Professor John Brady Endowed Professor in Biological Sciences Nicholls State University Business Address: Alcee Fortier Distinguished Service Professor John Brady Endowed Professor in Biological Sciences Department of Biological Sciences Nicholls State University Thibodaux **EDUCATION:** B.Sc. Zoology, University of Madras, India; 1979 M.Sc. Environmental Biology, Tamil Nadu Agricultural University, India; 1981 Ph.D. Environmental Biology, University of Madras, India; 1986 **UNIVERSITY RESPONSIBILITIES:** Responsibilities include Teaching Environmental Biotechnology, a Senior and Graduate level course, Marine and Environmental Biology (Graduate Course), Microbiology and Environmental Biology courses. Research interests include Bioremediation of Hazardous Chemicals and Anaerobic Microbiology. Service includes advising students, participate in Departmental and University committees and serving the local and regional communities. Advisor to Masters Program in Marine and Environmental Biology. **PROFESSIONAL EXPERIENCE:** January 2013 – Present: John Brady Endowed Professor in Biological Sciences, Department of Biological Sciences, Nicholls State University, Thibodaux. Teaching, Research, and Service to the University and Community. August 2012 – Present: Alcee Fortier Distinguished Service Professor, Department of Biological Sciences, Nicholls State University, Thibodaux. Teaching, Research, and Service to the University and Community. August 2004 – Present: Distinguished Service Professor, Department of Biological Sciences, Nicholls State University, Thibodaux. Teaching, Research, and Service to the University and Community. **MAJOR AREAS OF RESEARCH INTERESTS:** Anaerobic digestion, Composting, Biodegradation of hazardous chemicals. Antibiotic resistant bacteria and Antibiotic resistance genes in the aquatic ecosystem. Isolation and identification of novel bacteria. Anaerobic degradation of explosive chemicals with particular reference to sulfate reducing bacteria. Design and development of biological reactor systems. Microbial immobilization of

heavy metals and radionuclides. Alcohol production from agricultural residues. Water quality in the wetlands. Alternative to sugarcane burning, Biological control of termites. Organic ways to control land loss and coastal restoration.

KEYNOTE SPEAKER



Dr. Ing. Ahmad Taqwa, MT.

Director of Politeknik Negeri Sriwijaya Indonesia


Director of State Polytechnic of Sriwijaya, other than that, he is still active at Head of The Research and Publication Commission Forum Director of State Polytechnical In Indonesia, Founder of The Online Journalist Board (IWO) Sumsel, Chairman of The Advisory Board of UKM Nusantara Palembang and Assessor of Higher Accreditation Board. **EDUCATION:** Diplom Ingenieur Electrical Engineering HTL, Ingenieurschule Beider Basel, Switzerland; 1994, Magister (2005) and Doctoral (2010) at Electrical Engineering, Bandung Institute of Technology, Indonesia. **RESEARCH:** Head of Research Assignment “Mini PLTS Periodic Cooling System to Overcome Overheating in Palembang City” (2019), Member of The Research Assignment “Effects of Sea Salt Dust Collection on Output Loss and Solar Panel Output Efficiency” (2020), and Head of Research Assignment “Design and Build of Wireless Sensor Network Prototype Detection Of Landslides Based on IOT and LORA” (2020). **DEDICATION:** “The Design and Evaluation of Virus Scan in The E-Mail System in SMA N 5 Palembang” (2018), Assignment Service “Utilization of WSN Technology in Parking Air Monitoring Foundation SMP Harapan Mulia Palembang” (2019), Development of Teaching Materials with Interactive Multimedia with Education Game for Harapan Mulia Junior High School Students” (2020). **AWARD:** Certificate In Participating In The 200 Hour Advanced Technical Teacher Training awarded by FONTYS and PEDC (1998), Satyalancana Karya Satya X Year 2011 And Satyalancana Karya Satya XX Year 2017 by The President of The Republic of Indonesia. **WORKSHOP:** Seminar and Focus Group Discussion Forum The Rector of Indonesia “Economic Stability In The Vuca Area”, Ujung Pandang (2020), Workshop on Using Integrated Resources Information System Applications For Lecturers of State Polytechnical Polytechnic, Palembang (2019) And Workshop of Learning Methodology of Polsri Lecturers and Outside Education Domicile (PDD) as a Source Person, Palembang (2019).

RUNDOWN
The 5th FIRST 2021 INTERNATIONAL CONFERENCE
(FORUM IN RESEARCH SCIENCE AND TECHNOLOGY)
SNAPTEKMAS (Seminar Nasional Aplikasi Teknologi pada Masyarakat) 2021
Palembang, South Sumatera, Indonesia
Thursday, October 21, 20201

		Thursday, October 21, 20201			
No.	Session	Person in Charge	Time Allotment (WIB)	Liaison Officer	
1.	Registration	Event Section Committee	07.00 – 08.00	Doeslohal Djumrianti, S.E.MIS., Ph.D	
2.	The Opening Ceremony				
3.	Do'a				
4.	Indonesian National Anthem				
5.	Chair Report Speech	Event Section Committee	08.00 – 09.00		
6.	Speech and Opening Remarks by Director of State Polytechnic of Srijijaya				
7.	Souvenirs Gift, Group Photos				
PLENARY SESSION					
No.	Keynote Speaker	Affiliation	Time Allotment (WIB)	Moderator	Liaison Officer
1.	Dra. Nana Yuliana, MA., Ph.D.	The Indonesian LBBP Ambassador for the Republic of Cuba, concurrently with the Commonwealth of the Bahamas, Jamaica, the Dominican Republic and Haiti	09.00 – 10.00	Tiur Simanjuntak M.Pd.	Doeslohal Djumrianti, S.E.MIS., Ph.D
2.	Prof. Ramaraj Boopathy	Alcee Fortier Distinguished Service Professor of biological sciences at the Nicholls State University, USA	10.00 – 11.00	Prof. Hasan Basri	Dr. Nyayu Latifah Husni, M.T.
3..	Dr. Ing. Ahmad Taqwa, MT.	Director of Politeknik Negeri Srijijaya, Indonesia	11.00 – 12.00	Jaksen M. Amin, M.Si.	Dr. Martha Aznury, S.Pd., M.Si.

PARALLEL SESSION

No.	Theme	Room	Time	Moderator	Articles
1.	TRACK 1 (Engineering and Science)	1	13.00 – 16.00	Dr. Eng Tresna Dewi, M.Eng./ Ika Sulianti, ST, MT	15
2.	TRACK 1 (Engineering and Science)	2	13.00 – 16.00	Dr. Martha Aznury, M.Si./ Indah Purnamasari, M.Eng.	14
3.	TRACK 1 (Engineering and Science)	3	13.00 – 16.00	Fatahul Arifin, M.Eng, Ph.d./ Dr. Indrayani, S.T., M.T.	13
4.	TRACK 2 (Computer Science, Computer Engineering, Information System, Informatics Management)	4	13.00 – 16.00	Rika Sadariawati, M.Si./ M.Miftakul Amin, S.Kom., M.Eng	13
5.	TRACK 2 (Computer Science, Computer Engineering, Information System, Informatics Management)	5	13.00 – 16.00	Dr. Nyayu Latifah H, MT./ Lindawati, S.T., M.TI	12
6.	TRACK 3 (Social Science)	6	13.00 – 16.00	Doeslohah Djumrianti, S.E.MIS., Ph.D/ Dr. Marieska Lupikawati	13
7.	TRACK 3 (Social Science)	7	13.00 – 16.00	Dr. Sari Lestari ZR/ Dr. Rita Martini	14
8.	SNAPTEKMAS 1	8	13.00 – 16.00	Yumi Oklarina, ST, MT/ Mouland Irwadi, SE. M.Si.	15
9.	SNAPTEKMAS 2	9	13.00 – 16.00	Leni Novianti, M.Kom./ Maivi Kusnandar, M.Kom	15
10	SNAPTEKMAS 3	10	13.00 – 16.00	M Husni Mubarak, M.Si./ Martinus Mujur, ST, MT	15
11	SNAPTEKMAS 4	10	13.00 – 16.00	Dr. Ade Silvia H, MT./ M. Sopian Soim, ST, MT	13



CLOSING SESSION

Event	Time	Room
<ul style="list-style-type: none">- Closing Ceremony- Announcement of:<ol style="list-style-type: none">1. Best Paper FIRST IC 20212. Best Paper SNAPTEKMAS 20213. Best Presenter FIRST IC 20214. Best Presenter SNAPTEKMAS 2021- Quiz Online	16.00– 17.00	Main Room

TRACK 3 (Social Science)

ROOM : 6
 TIME : Thursday, 21 October, 2021/ 13.00 - 16.30
 ARTICLES : 13
 MODERATOR : Doeslohal Djumrianti, S.E.MIS., Ph.D/ Dr. Marieska
 Lupikawati

NO	Time	ID	AUTHORS	TITLE	AFFILIATION
1	13.00-13.10	3847	Ayu Chotibah, Bainil Yulina, Desi Apriyanty, Evada Dewata, Pridson Mandiangan	THE INNOVATION OF SOUTH SUMATERA TRADITIONAL BATIK E-COMMERCE APPLICATIONS	State Polytechnic of Sriwijaya
2	13.10-13.20	3683	M. Thoyib, Riza Wahyudi, Firmansyah, Darul Amri	THE ANALYSIS OF COST QUALITY ON PRODUCTIVITY OF IRON RAILING PRODUCTS IN SMALL AND MEDIUM BUSINESS IN PALEMBANG	State Polytechnic of Sriwijaya
3	13.20-13.30	3757/3756	Nelly Masnila, Firmansyah, Jovan Febriantoko, Riana Mayasari, Jamaliah Said	Quality of Financial Reporting and Impact of GGG Implementation: Study on Local Government in Indonesia	State Polytechnic of Sriwijaya
4	13.30-13.40	3796	Evi Agustina Sari, Sri Gustiani, Yusri, Tiur Simanjuntak	An Error Analysis of English Sentence Construction in Writing Subject Made by the Students of the English Department at Sriwijaya State Polytechnics	State Polytechnic of Sriwijaya
5	13.40-13.50	3827	Edwin Frymaruwah, Farah Aida Ahmad Nadzri, Periansya, Evada Dewata	DISCLOSURE OF SUSTAINABLE PERFORMANCE IN HIGHER EDUCATION IN INDONESIA	State Polytechnic of Sriwijaya, UiTM
6	13.50-14.00	3976	Hendra Hadiwijaya Febrianty Rezanía Agramanisti Azdy	Improvement of LPKA Class 1 Palembang Electronic Dashboard with Field Performance Monitoring	Palcomtech Polytechnic, STMIK PalComTech
7	14.00-14.10	3853/4034	Neneng Miskiyah, Purwati, Yulia Pebrianti, Keti Purnamasari, Nyimas Miftahul Jannah,	OPTIMIZATION OF INCOME PARAMETERS OF SONGKET CRAFTSMEN ON KOPERASI SONGKET PALEMBANG	State Polytechnic of Sriwijaya

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Characteristics of Palm Oil Solid Waste and Its Potency for Bio-Oil Raw Material

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ABSTRACT

The qualities of the raw materials utilized have a significant impact on the features of vegetable oil-based fuel products. The goal of this study is to find out what features palm oil solid waste has as a raw material for bio-oil production. In this study, shell and Empty Fruit Bunch (EFB) waste are compared to earlier research. The proximate analysis was carried out on a Carbolite Furnace, and the ultimate analysis on a Lecco CHN628 instrument, both in accordance with the ASTM test method. The findings of the typical tests reveal that the lower the O/C and H/C ratios, the higher the calorific value of a certain fuel, and vice versa. Palm oil solid waste has the potential to be employed as a raw material in the manufacturing of bio-oil, according to both ultimate and proximate studies.

Keywords: Bio-Oil, EFB, Palm Oil, Shell

1. INTRODUCTION

The number of fuel consumption recently from gasoline, kerosene, and also diesel are increasing. Data from the Ministry of Energy and Mineral Resources states that oil production in Indonesia is currently 55 million tons, where this production is estimated to only be able to meet Indonesia's fuel oil needs for the next 10 years [1][2]. Along with the lowering in oil production, national oil exploration activities encourage the research for alternative fuels as a substitute for petroleum-based energy supplies. The majority of the energy sources used in the world today are non-renewable natural resources, specifically fossil fuels in the form of oil and natural gas, with petroleum being widely used as a fuel in the power generation and transportation sectors. Bio-oil production is one of promising process to reduce dependence on fossil fuels [3][4].

Bio-oil is a type of fuel oil made from different organic oxygenate compounds and does not mix with fuel oils in general. They are called emulsions because of the high water content, which is around 15–20 percent and also serves as a binder for hundreds of distinct molecules [5][6]. Bio-oil can be used for household heating, boiler fuel, or direct drying fuel, and when filtered or improved, it becomes a purer and

higher calorie fuel that can be utilized for a variety of chemical industry demands, including petroleum fuel. Bio-oil is made from vegetable materials, especially from lignocellulosic materials, such as biomass from forestry waste, forest products industry, and agriculture [7][8].

There are many different types of vegetable oil-producing plants that can be utilized as raw materials for bio-oil with lignocellulosic content. However, these requirements frequently conflict with the community's production and food requirements. As a result, selecting raw materials for bio-oil is critical in order to avoid demand distortions between food and bio-energy needs. In Indonesia, several vegetable oil-producing plants are grown, one of which is palm oil. As is well known, the expansion of the palm oil region in Indonesia has tended to increase since the 1980s [9][10]. With an area of 1.22 million hectares and a plantation area capable of producing roughly 4.3 million tons of CPO, South Sumatra is one of Indonesia's top six largest oil palm plantations provinces. [11][12].

The palm oil industry produces waste every day consisting of liquid waste in the form of sludge oil and solid trash in the form of empty palm fruit bunches, fibers, and palm shells. Each ton of EFB (Empty Fruit

Bunches) will yield 22–23 percent, or roughly 220–230 kg of empty bunches, 6.5 percent, or 65 kg of shell waste, and 13 percent, or 130 kg of coir, from each process. There will be 23 tons of EFB produced in the palm oil sector with a processing capacity of 100 tons/hour and a 1 hour operation time. However, so far the waste usually used as animal feed or boiler fuel. Utilization of this type of palm oil waste is constrained by processing technology that is relatively inexpensive in preparing materials and requires a process to reduce the water content which is still quite high, even though the lignocellulose content of both shells and EFB is quite high, namely cellulose (41-46.5%), hemicellulose (25.3-33.8%), and lignin (27.6-32.5%) [13][14]. Based on these chemical components, both shells and EFB have the potential as raw materials for making biofuels through the pyrolysis process.

This study aims to determine the proximate and ultimate characteristics of palm oil solid waste and compare it with previous research that also has the potential as raw material for bio-oil production.

2. MATERIALS AND METHODS

2.1. Materials

The materials used in this research are Palm Kernel Shell (PKS) and EFB. Both PKS and EFB was obtained from one of plantation in South Sumatera, Indonesia.

2.2. Methods

2.2.1. Sample Preparation

Each PKS and EFB were weighed as much as 100 grams, then washed and dried under the direct sunlight. After drying process, the sample which is still in the form of chunks is crushed first using a Hammer Crusher to make it smaller. Furthermore, PKS and EFB were ground using a Raymond Mill tool to a size of 0.25 mm. Samples were stored in bottles and labeled. Further will be analyzed according to their functions at PT Carsurin.



(a)

(b)

Figure 1 PKS in form of (a) chunks and (b) smaller pieces



Figure 2 EFB (a) before size reducing and (b) after size reducing

2.2.2. Proximate analysis

2.2.2.1. Moisture

Empty crucible is weighed and recorded, then 1 gram of the sample is put into the crucible. After that, the crucible containing the sample is put into a furnace at a temperature of 104-110 °C for 1 hour. After reaching 1 hour, the crucible was removed and cooled in a desiccator for 10 minutes. Then proceed to the crucible weighing stage and the result is recorded to calculate the data analysis with the formula:

$$IM = \frac{m_2 - m_3}{m_2 - m_1} \times 100 \% \quad (1)$$

Note:

IM: Inherent Moisture

m1: Empty Crucible + Cover

m2: Empty Crucible + Cover + Sample

m3: Empty Crucible + Cover + Sample (From the Furnace)

2.2.2.2. Ash Content

Empty crucible is weighed and recorded, then 1 gram of the sample is put into the crucible. After that, crucible containing the sample was put into a furnace at a temperature of 500 °C for 1 hour. After reaching 1 hour, the temperature was raised to 750 °C for 1 hour. After the heating process is complete, the crucible is removed and cooled. Then proceed to the weighing stage which crucible containing the ash was weighed and the results are recorded to be calculated for the analysis data using the formula:

$$ASH = \frac{m_3 - m_1}{m_2 - m_1} \times 100 \% \quad (2)$$

Note:

Ash : Ash Content

m1 : Empty Crucible

m2 : Empty Crucible + Sample

m3 : Empty Crucible +Residu (From the Furnace)

2.2.2.3. Volatile Matter

Empty platinum crucible is weighed and recorded, then 1 gram of the sample is put into the platinum crucible. After that, platinum crucible containing the sample was put into a furnace at a temperature of 950 °C

for 7 minutes. After reaching 2-3 minutes make sure that the platinum crucible is tightly closed. After heated for 7 minutes, the platinum crucible was removed and cooled in a desiccator. Then proceed to the weighing stage of the platinum crucible containing ash, and the results are recorded for calculation of the analysis data using the formula:

$$VM = \frac{m_2 - m_3}{m_2 - m_1} \times 100 \% \quad (3)$$

Keterangan:

VM: Volatile Matter

m1 : Empty Platinum Crusible + Cover

m2 : Empty Platinum Crusible + Cover + Sample

m3 : Empty Platinum Crusible + Cover + Residu (From the Furnace)

2.2.2.4. Fixed Carbon

After the inherent moisture, ash content, and volatile matter have been obtained, the final calculation in the proximate analysis is to calculate the fixed carbon. Fixed Carbon cannot be calculated by direct testing in the laboratory, but by subtracting its impurity content, namely water content, ash content, and volatile matter with the formula:

$$\%FC = 100\% - (IM + ASH + VM) \quad (4)$$

2.2.2.5. Calorific Value

Each sample was weighed as much as 1 gram into a crucible, then put into a combustion vessel and then filled the bomb with oxygen gas to 2-3 mPa. The combustion vessel is placed into the bomb bucket, then close the bucket cover and the sample is analyzed using a Caloric Value Isoperbol tool. After the sample is burned, the caloric value will automatically appear on the monitor.

2.2.3. Ultimate analysis

2.2.3.1. Carbon, Nitrogen, and Hydrogen

The sample is weighed as much as 0.1 grams into tin foil, then the tin foil containing the sample is folded in a circle and then inserted into the Carousel, input the weight and sample ID on the Leco CHN628 instrument, then click "Analyze". The graph and analysis results will automatically appear on the monitor screen.

2.2.3.2. Sulfur

The sample is weighed as much as 0.2 grams into the crucible boat, then inserted into the Leco S832 instrument, input the weight and sample ID on the monitor screen, then click "Analyze". the graph and analysis results will automatically appear on the monitor screen.

3. RESULT AND DISCUSSION

The suitability of biomass as a fuel is influenced by moisture content, the material included (C, H, N, S, and O), volatile matter, and ash concentration [15]. The gravimetric method is used to determine the water content, volatile matter, ash content, and fixed carbon in proximate analysis. The final goal of EFB was to determine the percentage of carbon, hydrogen nitrogen, and oxygen in the shells, and the Leco CHN628 device was used to do it. The Parr 6200 Bomb Calorimeter was used to determine the calorific value of raw materials.

fuel classification is fundamental in determining its characteristics. Fuels can be divided into several groups that have the same properties regardless of their type and origin. Therefore, when biomass is considered for pyrolysis or other thermochemical conversions, its classification can be traced, then from these characteristics, we can assess its conversion potential [16].

Both PKS and EFB should be dried before further examination. The drying procedure is required for the next phase, which is to reduce the sample size using hammer mill tools. Table 1 and Table 2 show the results of the ultimate-proximate analysis and the calorific value of the shells and EFB of palm oil employed in this study in comparison to numerous other studies. Tables 1 and 2 are a comparison table of the findings of the investigation of PKS and EFB characteristics with the attributes of the same material collected from some literature. The literature was chosen based on a similar characteristic test of PKS and EFB, which would be employed as raw materials in the pyrolysis step to produce Bio-oil.

The atomic ratios of O/C and H/C obtained from the ultimate analysis can be used to show the amount of calorific value that can be used for certain fuels. The smaller the O/C and H/C, the more significant the calorific value in particular fuel, and vice versa. The results showed that the shell had a C content of 47.53%, and H content of 5.11%, and an O content of 36.14%. When viewed from the comparison in table 1, the ratio of C, H, and O in the shell research results is still in the range of C, H, and O ratios in the comparative literature. This shows that the ratio of O/C and H/C atoms owned by the shell is suitable for use as raw material for Bio-Oil. Likewise, the research results on TKKS are still within the range of ratios in the comparative literature. The C level in EFB is 54.5%, the H content is 5%, and the O content is 16.27%. The shell has a higher O and H ratio compared to EFB. Meanwhile, EFB has a higher C ratio than the shell.

Table 1. Results of Shell Analysis and Comparative Literature

Content	Unit	Method	Results	Comparative Literature			
				A	B	C	D
Proximate Analysis							
Moisture	%	ASTM D 3173-17a	19.58	-	3.87	11.9	6.3
Ash Content	%	ASTM D 3174-12	2.75	11.08	7.06	3.4	11.8
Volatile Matter	%	ASTM D 3175-18	69.78	73.77	72.34	66.8	62.8
Fixed Carbon	%	ASTM D 3172-13	19.37	15.15	20.61	17.9	19.1
Gross Calorific Value	MJ/kg	ASTM D 5865-13	19.20	16.3	19.15	15.89	17.02
Net Calorific Value	MJ/kg	ASTM D 5865-13	17.56				
Ultimate Analysis							
Carbon (C)	%	ASTM D 5373-16	47.53	48.68	68.45	55.82	46.7
Hydrogen (H)	%	ASTM D 5373-16	5.11	4.77	9.52	5.62	5.9
Nitrogen (N)	%	ASTM D 5373-16	0.32	1.17	0.2	0.84	1
Potassium (K)	%	ASTM D 3682-13	3.64	-	-	-	-
Sulfur (S)	%	ASTM D 4239-18e1	0.05	0.2	0.74	-	0.06
Oxygen (O)	%	ASTM D 3176-15	36.14	45.27	20.99	37.73	42

^A Idris et al (2012) [17], ^B Raju(2016) [18], ^C Lee *et al* (2013) [19], ^D Ahmad (2014) [20]

Table 2. EFB Analysis Results and Comparative Literature

Content	Unit	Method	Results	Comparative Literature			
				E	F	G	H
Proximate Analysis							
Moisture	%	ASTM D 3173-17a	13.66	6,17	7,95	-	5.18
Ash Content	%	ASTM D 3174-12	8.74	5,80	5,36	3,11	3.45
Volatile Matter	%	ASTM D 3175-18	58.66	76,09	83,86	81,9	82.58
Fixed Carbon	%	ASTM D 3172-13	18.90	18,15	10,78	12,6	8.79
Gross Calorific Value	MJ/kg	ASTM D 5865-13	15.49	18,72	17,08	-	17.02
Net Calorific Value	MJ/kg	ASTM D 5865-13	12.44				
Ultimate Analysis							
Carbon (C)	%	ASTM D 5373-16	54.45	66.17	49,07	53.78	46.62
Hydrogen (H)	%	ASTM D 5373-16	5.00	9.54	6,48	4.37	6.45
Nitrogen (N)	%	ASTM D 5373-16	1.83	1.51	0,7	0.35	1.21
Potassium (K)	%	ASTM D 3682-13	0	-	-	-	-
Sulfur (S)	%	ASTM D 4239-18e1	0.05	0.06	0,10	0	0.04
Oxygen (O)	%	ASTM D 3176-15	16.27	22.72	38,29	41.5	45.7

^E Raju (2016) [18], ^F Yang *et al* (2006) [21], ^G Abdulah and Gerhauser (2008) [22], ^H Mohammed (2012) [23]

Proximate analysis is used as an indicator to show how well the biomass is converted into energy. The greater the ratio between fixed carbon and volatile matter, the more it can release chemical energy [8]. Based on the research results, the shell has a fixed carbon value of 19.37% and a volatile matter value of 69.78%. Both are still included in the range of research results from the comparative literature. As for the EFB, the volatile matter value it has is 58.66%, where this value is relatively small and outside the range of research results in the comparative literature. Then for the fixed carbon value owned by EFB itself is 18.90%, where this value is slightly larger than the range found

in other studies. This means EFB itself is not necessarily unable to release chemical energy.

Based on the comparison in Tables 1 and 2, it can be seen that the %moisture in the shell and EFB is greater than the %moisture in the comparative literature. The range of shell moisture % obtained from the literature ranged from 3.87 to 11.9, while the EFB moisture % ranged from 5.18-7.95. The research shell had %moisture 19.58, and the EFB from the study had %moisture of 13.66. This is because the drying process on the material has not run perfectly. High moisture content can hamper the pyrolysis process due to the presence of moisture in the raw material. Then for the

ash content, the shell has an ash content of 2.75%, where this value is relatively minimal compared to the amount of ash content found in other studies, namely 3.4% - 11.8%. As for EFB, the ash content is 8.74%, where this value is relatively more significant than other studies, namely 3.11%-5.8%. Moisture content and ash content are two parameters that are detrimental to fuel quality. High moisture content reduces the calorific value of fuel, while high ash content can increase operating costs [24].

For the calorific value, the results showed that the calorific value of PKS 19.20 MJ/kg and EFB 15.49 MJ/kg were among the values in the comparison literature due to the high percentage of C atoms contained in them. This shows that PKS and EFB have good combustion capabilities, so that they are suitable for use as raw materials for making Bio-oil through the pyrolysis stage.

4. CONCLUSION

From the results of proximate and ultimate analysis, it is seen that most of PKS and EFB consist of volatile materials. With high levels of volatile materials, it is hoped that large quantities of gas and liquid from the pyrolysis process can be obtained. The carbon and oxygen content in the PKS are greater than the EFB, this indicates that the bio-oil from the PKS during pyrolysis will have more oxygen levels than the EFB. The sulphur content in the PKS and EFB is the same, namely 0.05 according to fuel standards below 1-2%, so the bio-oil produced will be environmentally friendly. Meanwhile, the calorific value of the PKS is greater, namely 19.20 MJ/kg and EFB 15.49 MJ/kg. This shows that PKS have a greater heat than EFB. Both PKS and EFB of palm oil have the potential to produce bio-oil through the pyrolysis process.

AUTHORS' CONTRIBUTIONS

Rusdianasari participated in the conception and design of the study. Leila Kalsum and Nelly Masnila contribute in manuscript preparation. Leila Utarina analyzed the data and wrote the paper. Daya Wulandari conducted the experiments and calculated the data. All authors read the manuscript, contributed to manuscript changes, accepted the final version of the work, and agreed to be held responsible for its content.

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