PROCEEDINGS

2015 3rd International Conference on Adaptive and Intelligent Agroindustry (ICAIA)

ICAIA 2015

August 3rd - 4th, 2015
IPB International Convention Center
Bogor, Indonesia

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INDONESIA SECTION

Proceedings of

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Bogor Agricultural University

Bogor, Indonesia

Welcome Message from The General Chairs of ICAIA 2015

On behalf of the organizing committee, it is our pleasure to welcome you to International Conference on Adaptive and Intelligent Agroindustry, Bogor, Indonesia. This is the 3rd conference on the topic that is held by the Department of Agroindustrial Technology, Bogor Agricultural University, Indonesia.

The conference is expected to provide excellent opportunity to meet experts, to exchange information, and to strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry. In addition, the conference committee invited five renowned keynote speakers, i.e. Prof Irawadi from Bogor Agricultural University; Prof Kenneth De Jong from George Mason University, USA; Dr Yandra Arkeman from Bogor Agricultural University; and Dr Guillermo Baigorria from University of Nebraska-Lincoln, USA.

The conference committee also invited Prof Noel Lindsay from University of Adelaide, Australia; Kiyotada Hayashi from National Agricultural Research Center-Tsukuba, Japan; Prof Margareth Gfrerer from Islamic State University of Jakarta, Indonesia; Dr Barry Elsey from University of Adelaide, Australia; Dr Gajendran Kandasamy from Melbourne University, Autralia; and Imperial College London-British, Prof Allan O'Connor from University of Adelaide, Australia; Dr Wisnu Ananta Kusuma from Bogor Agricultural University ,Indonesia; and Dr Frank Neumann from University of Adelaide, Australia, as invited speakers.

This conference was organized by Department of Agroindustrial Technology, Bogor Agricultural University and Asosiasi Agroindustri Indonesia, and technically sponsored by IEEE Indonesia Section. Furthermore, it was supported by Departement of Computer Science, Bogor Agricultural University; Surfactant amd Bionegergy Research Center; PT Bogor Life Science and Technology; Indonesian Ministry of Industry; PT Pachira Distrinusa; and PT Kelola Mina Laut.

I would like to take this opportunity to express my deep appreciation to the conference's committee members for their hard work and contribution throughout this conference. I would like to thank authors, reviewers, speakers, and session chairs for their support to participate in the Conference. Lastly, I would like to welcome you to join ICAIA 2015 and wish you all an enjoyable stay in Bogor.

Sincerely,
Dr Yandra Arkeman
General Chairs, ICAIA 2015

WELCOMING ADDRESS

Prof. Dr. Ir. Nastiti Siswi Indrasti
Head of Agroindustrial Technology Department
Faculty of Agricultural Engineering and Technology
Bogor Agricultural University

on

3rd International Conference on Adaptive and Intelligence Agroindustry (3rd ICAIA)

Bogor, August, 3 – 4, 2015

Assalamu'alaikum Warohmatullahi Wabarokatuh
In the name of Allah, the beneficent and the merciful,

Distinguish Guest, Ladies and Gentlemen
Let me first thank you all for accepting the invitation to participate in this 3rd International Conference on Adaptive and Intelligence Agroindustry (ICAIA). In particular I would like to thank Rector of IPB (Institut Pertanian Bogor/Bogor Agricultural University) Prof. Herry Suhardiyanto for supporting this event as part of the series academic event in celebrating the 52nd Anniversary of Bogor Agricultural University.

We are certainly proud to have been able to assemble this event in IPB, Bogor. The range of participants and audience at this conference is precisely something I would like to stress. Participants who followed the event more than 150 people, coming from various countries including the USA, Australia, Japan, Vietnam, Philippine, Germany and Indonesia. The main goal of the conference is to provide an effective forum for distinguished speakers, academicians, professional and practitioners coming from universities, research institutions, government agencies and industries to share or exchange their ideas, experience and recent progress in Adaptive and Intelligent Agroindustry.

The 2015 3rd International Conference on Adaptive and Intelligent Agro-industry (ICAIA) is the third forum for the presentation of new advances and research results on various topics in all aspects of innovative agro-industry that highlights the development and improvement for today and tomorrow's global need for food, energy, water and medicine. The aim of the conference is to stimulate interaction and cohesiveness among researchers in the vast areas of innovative agro-industry. Innovative Agro-industry has the ability to adapt intelligently to future global challenges, i.e. food, energy, water, and medical. Global challenges needs a new breed of Agroindustry which could produce innovative products to fulfill the needs through advanced processing technology, production systems and business strategy supported by cutting-edge information and communication technology.

The topic for this event is "Empowering Innovative Agroindustry for Natural Resources, Bioenergy and Food Sovereignty". The topics clustered into four main parts:
Track 1 : Innovative Agroindustrial and Business System Engineering

Track 2 : Frontier Approaches in Process and Bioprocess Engineering
Track 3 : Frontier Approaches in Industrial Environmental Engineering
Track 4 : Intelligent Information and Communication Technology for Adaptive Agroindustry of the Future

This event also hosts four (4) workshops: (1) Strategies for Agroindustry Development (2) LCA for Agroindustry (3) Innovation and Technopreneurship for Agroindustry and (4) Agroindustry Informatics.

Distinguish Guest, Ladies and Gentlement,
Agroindustry transforms agricultural commodities into high value-added products. Agroindustry is industry that process agricultural products to increase their value added significantly by using technology and by considering environmental aspect and sustainability. However, with changing global demand and technology advancement, innovative agroindustry is needed in order to be competitive as well as sustainable. The challenge of future agroindustry is not merely efficiency and productivity anymore, but also the challenge to appropriately apply frontier technology as well as meeting future global demands.

Agroindustry needs to deal with the application of advance technologies and cope future global issues. Current global issues which arise and expected to exist in the future are food sovereignty, renewable energy, sustainable water management and pharmacy. The ability of agro-industry to respond the future global issues and the undoubtedly substantial increase in demand in future decades will be highly dependent on the increased application of existing technologies as well as the exploitation of new and innovative technologies.

The emergence of high technology could be applied in the agro-industry are: nanotechnology, biotechnology, bioinformatics, food processing, food packaging-waste, state-of-the-art computation and many others. The aforementioned high-technology along with computation technology could greatly advance agro-industry from a traditional system into a smart-intelligent and innovative technology. Therefore, in the new millennia, adaptive-intelligent and innovative agro-industry will contribute to solutions to global problems and brings agriculture into perfection.

Hope this conference will also discuss this issue in more detail as it is an important matter for all of us. We should no more think just how to produce high value product but it is also necessarily important how to keep our live in good quality by understanding following old saying… “You do not live at once. You only die once and live every day”.

I do not to take up any more of your time with these opening remarks. Let me simply thank you once again for sharing your thoughts with us. Here’s wishing every success for the conference. May Allah bless all of us.

Thank you for your kind attention,
Wassalamu’alaikum Warohmatullahi Wabarokatuh

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AGENDA

Time	Activities
Monday, August 3rd 2015	
08.00 - 09.00	Registration
09.00 - 10.00	Opening Ceremony • Welcoming Address: Prof. Nastiti Siswi Indrasti (Head of DAT, Fateta, IPB) • Welcoming Speech Head of Bogor Regency • Conference Opening: Prof. Herry Suhardiyanto (Rector of IPB) • Opening Speech and Conference Opening : Minister of Industry Indonesia * • Launching Expose International program DAT
10.00 – 10.05	*Photo Session*
10.05 - 10.15	*Coffee break*
	Keynote Speech :
10.15 - 10.45	1. Prof Irawadi (Bogor Agricultural University, Indonesia)
10. 45 - 11.30	2. Prof. Kenneth De Jong (George Mason University, USA)
11.30 – 12.00	3. Dr. Yandra Arkeman (Bogor Agricultural University, Indonesia)
12.00 – 12.30	4. Dr. Guillermo Baigorria (University of Nebraska, Lincoln, USA)
12.30 – 13.30	Lunch break
	Plenary Session 1 :
13.30 – 13.50	Prof. Noel Lindsay (University of Adelaide, Australia)
13.50 – 14.10	Dr. Kiyotada Hayashi (National Agricultural Research Center, Tsukuba, Japan)
14.10 – 14.30	Prof. Margareth Gfrerer (Islamic State University of Jakarta, Indonesia)
14.30 – 14.50	Dr. Barry Elsey (University of Adelaide, Australia)
14.50 – 15.10	Ir. M. Novi Saputra (Marketing Director KML Food Group)
15.10 – 15.45	*Discussion*
15.30 – 15.45	*Coffee break*
15.45 – 18.00	Parallel session A, B and C
18.00 – 21.00	Welcome Dinner

Time	Activities
Tuesday, August 4rd 2015	
08.30 – 09.00	Registration
 09.00 – 09.20 09.20 – 09.40 09.40 – 10.00 10.00 – 10.20 10.20 – 10.45	Plenary Session 2 : Dr. Gajendran Kandasamy (PhD in Physic, Melbourne University ; PhD in Innovation Imperial Collage, London) Prof. Allan O'Connor (University of Adelaide, Australia) Dr. Eng. Wisnu Ananta Kusuma, ST, MT (Bogor Agricultural University, Indonesia) Dr. Frank Neumann (University of Adelaide, Australia) *Discussion*
10.45 – 13.00	Parallel Session A, B and C
13.00 – 14.00	Lunch break
14.00 – 15.30	Parallel Workshop • Strategies for Agroindustry Development • LCA for Agroindustry • Innovation and Technopreneurship for Agroindustry • Agroindustrial Informatics
15.30 – 15.45	Coffee Break
15.45 – 16.15	Closing remark

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New Trends in Industrial Environmental Engineering & Management

Intelligent Information & Communication Technology for Adaptive Agroindustry of the Future

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Innovation Briquette of Fronds Oil Palms Through Non Carbonization Process

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***Abstract* - The development of fuel biobriket is one attempt to overcome the problem of the energy crisis, especially for household cooking needs. Currently, briquettes made from waste oil palm fronds are already being developed. Availability of abundant raw materials and process technology is growing, causing briquettes of the palm fronds to be cheaper compared to other biomass briquettes. One process that can be applied to obtain more economical results is through a non-carbonization process. The results of the study, using three types of specimens, has obtained the highest calorific value of 3,477.67 kCals/kg, the production cost of 830 IDR/kg and with a selling price that can be offered to consumers 1,300 IDR/kg.**

I. Introduction

Currently, the energy needs of the Indonesian society is still highly dependent on fossil fuels. For households, the majority of energy needs relied on oil and LPG. Therefore, the search for alternative fuels will lessen the burden on these types of fuels and create a healthier enviromnent while increasing profits.

Indonesia's energy consumption continues to increase at the historical average growth of 3.09% per year, from 2000 until 2010, where the number rose from 737 million BOE in 2000 to 1.012 million BOE in 2010. The highest energy consumption is dominated by the use of fuel oil in 2010, which reached a total of 31%, while biomass consumption in the form of firewood and charcoal at 28%, and the use of gas and coal by 13%. On the other hand, the supply of energy, particularly oil, in 2010 reached 344.89 million BOE with proven reserves, which can only provide oil for 11 years [1].

While the subsidized fuel quota for the year 2010, is as much as 38.228 million kiloliters and non-subsidized fuel quota until 2010 is as much as 27.041 million kiloliters, Indonesia has been importing fuel from other countries amounted to 26.02 million kiloliters [1].

As an agricultural country, Indonesia has a very large potential of biomass energy. Utilization of biomass energy has long been done and includes the oldest energy which role is very great, especially in the countryside. It is estimated that approximately 35% of total national energy consumption comes from biomass. The energy generated has been used for various purposes. For example, household needs (cooking and home industry), drying the agricultural harvest and timber industries, power plants in the timber industry and sugar [2].

One source of biomass energy that can be generated through the processing of agricultural waste is a solid fuel known also with briquettes. Basically, the briquettes can be generated through unused materials such as garbage, sawdust, rice husks or coconut shells. In studies that have been carried out, an alternative source of raw materials that will be used to produce briquettes are wastes produced by oil palm plantations, in this case is a waste of palm fronds.

This experimental research aimed at creating new innovations in alternative energy, especially through the utilization of raw materials such as waste oil palm fronds. Through the use of alternative energy sources, such as palm oil fronds briquette, it is expected to increase economic value and benefits to meet the needs of cooking in rural areas.

II. Literature Review

A. *Innovation Concept*

Innovation is the conceptualization activity and ideas to solve the problem by delivering economic value for the company and social value for the community. Innovation started from existing condition, then a new condition was created (value-added) [3]. Innovation can be classified into several types, such as administrative innovation, technical innovation, product/ service innovation, process innovation, radical innovation, and incremental innovation [4].

Administrative innovation is related to the organizational structure and administrative processes that are not directly related to the basic activities and work of an organization. This is directly related to the Company's management. *Technical innovation* is related to technology products, services, and production processes. *Product innovation* is a new product or service that was introduced by outside users or because of market requirements. *Process innovation* is a new element introduced in a

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production company or service operations. Its uses input from raw materials, specification of tasks, jobs and information, and equipment used for the production of a product or making services.

Furthermore, *radical innovation* and *incremental innovation* can be defined as the degree of the changes made in the implementation of enterprise adoption. *Radical Innovation* is a reorientation and innovation that are nonroutine basic procedures and the company's activities show a clear beginning of an implementation of the innovation. While *incremental innovation* is innovation routine, varied and instrumental [4].

B. Technological Innovation in briquetting

Briquette is one of the alternative fuels that can be used as a substitute for firewood cooking, especially on households that are located in rural areas. Various organic wastes have been widely used as raw material for making briquettes. Some of them are sawdust [5], rice husks, [6], a mixture of coconut shells and sawdust, [7], [8], corn cob [9], [10]. In addition, agricultural wastes also started to be used in producing the briquettes from oil palm plantations. Some parts of palm oil can be used as raw material for producing the briquettes include palm shells [11], empty fruit bunches [12], and also oil palm fronds or midrib [13].

Waste oil palm fronds are the most numerous and not fully utilized. Each harvesting, as many as 7-10 palm fronds, which should be cut down to make it easy for the process of taking fresh fruit bunches of oil palm. Palm fronds that had been cut down, are usually just stacked side section under the oil palm trunk. Its take a long time for decomposition and fertilization to occur naturally.

Generally, the process of briquetting is mostly done through the carbonization process, where the raw materials that have been destroyed, especially during altering process before the pressing process. But now, many researchers who have done briquetting without carbonization process [14]. In producing briquettes through the non carbonization process, requires certain adhesive materials such as starch and sago [15].

The parameters that must be considered in producing briquettes include ash content (ash content), water content (moisture), the levels of volatile matter (volatille matter), activated carbon, as well as the value of the pressure exerted. To obtain a quality briquettes with high calorific value, moisture content should be no more than 15%. Water content is strongly influenced by the duration of the drying process as well as the adhesive substance that is used [16]. Furthermore, the length of the ignition briquette influences the level of pressure exerted during the pressing process.

Briquettes produced through non-carbonization, relatively cheaper and efficient than the briquettes produced carbonization. This is because, on the non-carbonization process does not require the combustion process and generally shorter than the carbonization process.

C. Oil Palm Fronds.

Oil palm (Elaeis guineensis Jacq) is a plant made up of pieces that includes family Palmae. Elaeis genus name is derived from the Greek word meaning oil, while guineensis species originating from Guinea, which is a place where a botanist named Jacquin discovered oil palm plantations were first on the coast of Guinea [17]

Palm fronds or midrib oil palm is a kind of solid waste generated during the year by oil palm plantations. Palm frond containing lignin (24.5-32.8%), hemicellulose (20.5-21.83%), cellulose (54.35-62.6%), extractive substances (2.35- 13.84%), silica (1.6-3.5%), and ash (2.3-2.6 %). On palm leaf midrib cross section consists of two parts the cortex and central vascular, while the palm leaf midrib microscopically consists of three major vascular, skin, basic parenchyma and xylem.[18].

D. Energy Value in Palm Oil Waste

At this time, oil palm plantations have great potential to be converted into a variety of energy products. In addition to its main products produce palm oil (Crude Palm Oil - CPO), waste from oil palm plantations have also been developed to produce a variety of other byproducts. The types of waste palm oil in the first generation are solid waste consisting of empty fruit bunches, fronds or midrib and shell.

The energy content of several palm oil waste, can be described in the Table I, [19] :

TABLE I
CALORIFIC VALUE OF THE ENERGY FROM WASTE OIL PALM (BASED ON DRY WEIGHT)

Waste	Mean of Calorific Value (kJ/kg)	Calorific Range (kJ/kg)
Empty Bunches	18.795	18.000 - 19.920
Fiber	19.055	18.800 – 19.580
Shell	20.093	19.500 – 20.750
Stem	17.471	17.000 – 17.800
Fornds/ Midrib	15.719	15.400 – 15.860

E. Briquette Process Technology

Generally, the process of making all kinds of briquettes is the same, that is by giving pressure to the ash from the combustion or refining of raw materials so that the raw materials form a solid powder.

Briquetting technology can be divided into three ways [20]:

- High pressure briquetting.
- Briquetting pressure with heating medium.
- Low pressure briquetting with binder.

Briquette processing can be done by carbonization and non carbonization processes. To produce briquettes without carbonization process, use the following steps :

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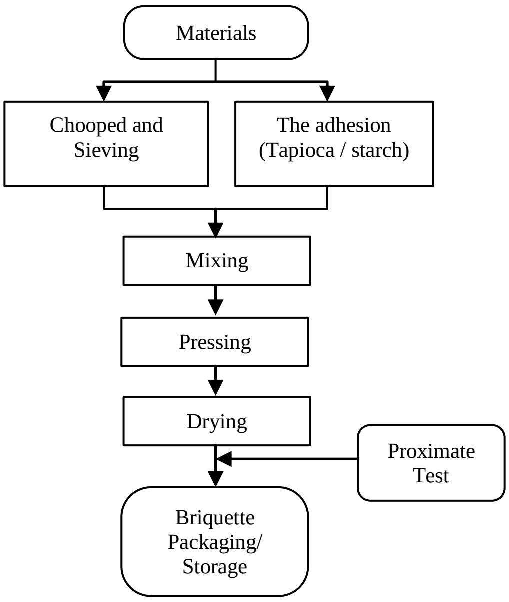

Fig 1. Briquette Non Carbonization Process

F. Proximate Test of Briquette

Proximate test is performed to determine the characteristics of solid fuel. In this study, conducted proximate test consists of three tests, such as calorific measurement, test the moisture content and ash content test [19].

a. Calorific Measurement

Calorific values determine the quality briquettes. To determine the calorific value of a solid fuel, the testing is done by using kaloribomb meter. Calorific value of briquettes, can also be measured by the following equation. First, calculate the highest heat value (HHV) by the equation :

$$HHV = (T_2 - T_1 - T_{kp}) \text{ x } c_V \text{ (kj/kg)} \qquad (1)$$

while, the lower heating value (LHV) is calculated the equation according to the formula:

$$LHV = HHV - 3240 \text{ (kj/kg)} \qquad (2)$$

where, T1 are temperatures of the cooling water before it is turned on (^oC), T2 are temperatures after the cooling water is turned on (^oC), Tkp are temperatures rise of the wire igniter = 0.05 (^oC), and Cv are Heat types of tools = 73,529.6 (kJ / KGC).

b. Water Content Test

Test the water content is done by comparing the weight of chips before being dried with a weight of chips after being dried by using a machine and a drying oven under the hot sun. Formulation:

$$\text{Water Content (\%)} = \frac{G_0 - G_1}{G_0} \times 100\% \qquad (4)$$

where,
G_0 = sample weight before drying (g)
G_1 = weight of sample after drying (g).

c. Ash Content Test

Furthermore, ash is the remaining part of the combustion products, in this case is the combustion of briquettes. One of former of the ash is silica. Unfavorable influence on the calorific value of briquettes, it can cause the quality of the briquettes to be low [21].

The ash content can be measured by the following equation :

$$\text{Ash Content (\%)} = (C/A) \text{ x } 100\% \qquad (5)$$

where:
A = weight of the material before combustion (g)
C = The weight of ash / residue after combustion (g)

III. MATERIALS AND METHODS

The innovation in the use of oil palm fronds into briquettes is designed in a research experiment. Design of experiments is defined as a series of activities and tests that aim to make changes to the input variables of the process or system so that we can know and identify the cause of a change in output. Experimental design can used to interpret a study design with every step and action that truly defined such that information relating to can be studied and obtained.

A. Materials

In this study, is the use of oil palm fronds or midrib as the main raw material. Midrib obtained from three different places, such as from the local palm oil in Pekanbaru (K1), midrib of palm oil plantations in PT Asian Agri (K2) and the midrib of palm plantations located in the area of Kampar Kiri Danau Raja (K3).

B. Stage of Processes.

In designing briquettes from palm fronds, there are several stages of processing, which describes the process of making briquettes. The stages of the experiment in making briquettes from oil palm fronds are shown at fig-1.

a. Preparation of Raw Materials

The main raw material used to produce briquettes are palm fronds. To produce good midrib and simplify subsequent process, first, it is necessary to remove the leaves and palm leaf rib that exist in stems of midrib. Two-thirds of the midrib is used the rost is discanded due to its hardness and large size, which can damage the machine chooper. After the cleaning process of leaves and palm leaf rib, palm fronds have an average weight of 7 kg. Next, midrib cut into smaller pieces (approximately 0.5 until 1 m) to make ease the process of chopping.

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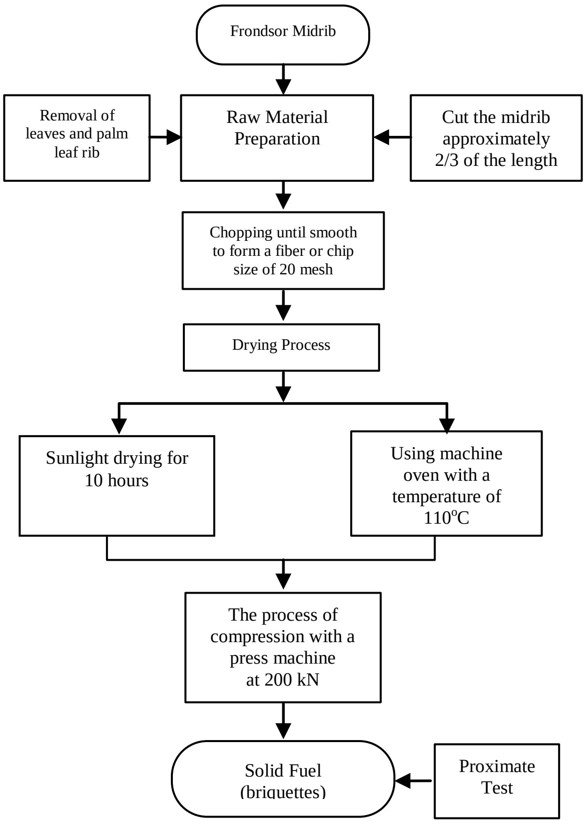

Fig 2. Diagram of fronds oil palms briquette processes

b. Chooping Process

In this experiment, the process of chopping is done in three ways and with different equipment. Thus, yield results different of the chopper. For the first specimen (K1), the process is done by using coconut grater machines. Then for the second specimen (K2), done using machines chooper-1. And for the third specimen (K3) was performed using machine chooper-2. The results of these three tools chopping process can be seen in the fig 3.

Fig 3. Results of the process chopping with Three different tools

c. Drying Process

The drying through two processes, such as drying material under the sun, or can be done using equipment such as machine oven. To enable the raw material to dry completely, it needs to be done drying process by using machine oven at 110oC temperature for 10 hours.

After the drying process using the oven, the drying process can continue under the hot sun directly. It aims to ensure that water vapor is trapped inside the chips can be completely lost. The results of the drying process that has been done by several methods, can be seen in the following figure.

Fig 4. Results of drying process

d. Weighing Process

In order to obtain the mass of a standard size, the raw materials that have been dried to be weighed. This process is done to facilitate the briquetting process with a view to making briquettes with almost the same weight. It uses digital weighing scales with three variations of weight, which is 20 grams, 30 grams and 50 grams.

Fig 5. The result of the weighing process

e. Moulding Process with Press Machine

The next process is the process of molding the raw material into bars of briquettes using a press machine with an average pressure of 200 kN. The higher the level of pressure, will give best results. The high value of pressure will affect the duration of the combustion process briquettes.

Fig 6. Results of the briquetting process

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IV. RESULTS

A. Proximate Test Results

The results of measurements of heat from the existing three specimens can be seen in the following table :

TABLE II
CALORIFIC VALUE TEST RESULTS

Specimens	Calorific Value (kJ/kg)	Calorific Value (kCal/kg)
K1	14,550.90	3,477.67
K2	13,288.11	3,175.86
K3	13,436.49	3,211.32
Rat-rata	13,758.50	3,288.28

Through the table it can be seen that, the highest calorific value found in first raw material (K1), is 14,550.90 kJ / kg, equivalent to 3,477.67 kCal / kg. Whereas the average heat that can be generated from the three specimens is equal to 13,758.50 kJ / kg, equivalent to 3,288.28 kCal / kg.

Moisture content before briquetting process contained in the raw material, are as follows:

TABLE III
WATER CONTENT TEST RESULTS

Specimen	Initial weight (gr)	Dry weight (gr)	Water weight (gr)	Water Contents (%)	Biomass Contents (gr)
K1	1,614.7	613.6	1001.1	62.0%	38.0%
K2	975.4	416.4	559.0	57.3%	42.7%
K3	1,379.8	464.4	915.4	66.3%	33.7%

Differences in the test results briquettes moisture content of oil palm fronds are due to the different stages of manufacture of the briquettes palm fronds with other biobriket. This is due to the process of briquetting palm fronds, the testing phase moisture content is calculated after the raw materials undergo a drying process prior to the briquetting process. While, on the other biobriquette, testing the water content is done after the press process.

Furthermore, the ash content of the briquettes, can be seen through next table:

TABLE IV
ASH CONTENT TEST RESULTS

Specimens (gr)		Initial Weight (gr)	Residu Weight (gr)	Ash Content (%)
K1	1	20	0.24	1.20%
	2	30	0.76	2.53%
	3	50	2.25	4.50%
K2	1	20	0.33	1.65%
	2	30	0.61	2.03%
	3	50	3.19	6.38%
K3	1	20	1.67	8.35%
	2	30	2.68	8.93%
	3	50	6.29	12.58%

B. Economic Value Analysis

Some of the key aspects in determining the economic value of the product briquettes include: capacity of production equipment, raw material prices, cost of production, as well as the expected profit margin.

In this study, pembriktan done using equipment with a capacity of up to 1,260 kg / day. In addition, capacity chooper machine and drying machine each is 7,000 kg / day and 3,000 kg / day. The following table, describes the the full capacity of machine and the number of machines needed to produce briquettes palm fronds.

TABLE V
CAPACITY AND THE NUMBER OF MACHINES

Machine	Maximum Capacity (kg)	Capacity in Use (kg)	Output (kg)	Eff (%)	Qty (Unit)
Chooper	7,000	2,071.72	1,968.13	29.60%	1
Dryer	3,000	1,968.13	1,082.47	65.60%	1
Press	1,260	1,082.47	1,050.00	85.91%	1

To produces 1,050 kg of briquettes, require raw materials 2,071.72 kg midrib, or as much as 259 kg rod, (assuming a weight of 1 stem midrib is 8 kg). In the process of briquette production drying process causing severe depreciation very large, up to 45%. This is because, at this stage of drying the chip should be completely non water.

To produce briquettes, require the production costs, including the cost of purchasing raw materials, labor cost, cost of energy needs, cost of purchase of equipment and depreciation costs

Totally, requirement of production cost are Rp. 871,000/day. It means, to produces 1 kg of briquettes, it will cost Rp. 830. So, if the maximum profit margin of 50%, the product briquettes can be marketed at a price of Rp. 1,300/kg.

When compared with kerosene and gas (LPG), the selling price of briquettes, relatively much cheaper. In Indonesia, currently for 3 kg LPG is sold at 4,750 IDR/kg, while kerosene is 2,500 IDR/lt or 3,125 IDR/ kg (assuming the density of kerosene is 0.8 kg/lt) [22]. However, due to very limited supply, the price of kerosene in the market, could reach 15,000 IDR/lt or equivalent to 18,750 IDR/kg. The calorific value that can be produced from the kerosene is 11,000 kCal / kg, LPG gas amounted to 11,900 kCal /kg [23]. Meanwhile, heat oil palm fronds briquettes amounted to 3,477.67 kCal/kg.

By comparing between the selling price and the calorific value that can be produced by each of the fuel, it can be seen that the price/calorie kerosene is 1.70 IDR and price/calorie LPG is 0.39 IDR. While palm oil briquettes, value price/calorie is 0.37 IDR. So, from the comparison, palm fronds briquettes more efficient than kerosene and LPG gas.

TABLE VI
EFFICIENCY CALORIFIC VALUE KEROSENE, LPG AND BRIQUETTES OF OIL PALM FRONDS

Fuels	Calorific (kKal/kg)	Prices (IDR/kg)	Price/kCal (IDR/kKal)
Kerosene	11,000.00	15,000	1.702
LPG	11,900.00	4,750	0.399
Briquette	3,477.67	1,300	0.373

V. CONCLUSION

Innovation on design product of alternative energy that was done in this study, produced one of the solid fuel in the form of briquettes by utilizing waste oil palm fronds. It is very important to continue to carry out the process of innovation, particularly in the development of new sources to meet growing energy needs. Various strategies can be applied innovations, both from a technical aspect as well as from other aspects.

To produce innovative products, many ways that can be done, including through elaboration and combination of the results of research and development has been done by previous researchers, will be a starting point in creating innovative products that have economic value in the future.

REFERENCES

[1] BPPT, "Outlook Energi IndonesiaTahun 2013.

[2] Syamsiro dan Saptohadi, "Pembakaran Briket Biomassa Cangkang Kakao : Pengaruh Temperatur Udara Preheat". Makalah Seminar Nasional Teknologi, Yogyakarta, 2007.

[3] Shilling, M.A., "Strategic Management of technologycal Innovation" . New York: Mcgraw-Hill, 2005.

[4] Damanpour, *Organizational Innovation: A Meta-Analysis Of Effects Of Determinants and Moderators.* Academic of Management Journal, September 1, 1991 34:3 555-590;

[5] Imoisili *et.al*, *Production and Characterization of Hybrid Briquette from Biomass*, British Journal of Applied Science & Technology, 2014.

[6] Jamilatun, *Kualitas dari Sifat-sifat Penyalaan dari Pemabakaran Briket Tempurung Kelapa, Briket Serbuk Gergaji Kayu Jati, Briket Sekam Padi dan Briket Batubara.* Proseding Seminar Nasional Teknik Kimia, Yogyakarta, 2011.

[7] Yudanto & Kusumaningrum, "Pembuatan Briket Bioarang dari Arang Serbuk Gergaji Kayu Jati*",* Jurusan Teknik Kimia, Universitas Diponegoro, 2008.

[8] Ndaraha,"Uji Komposisi Bahan Pembuatan Briket Bioarang Tempurung Kelapa dan Serbuk Gergaji terhadap Mutu yang Dihasilkan*",* Departemen Teknologi Pertanian, Fakultas Teknik, Universitas Sumatera Utara, Medan, 2009.

[9] Surono, *Peningkatan Kualitas Pembakaran Biomassa Limbah Tongkol Jagung sebagai Bahan Bakar Alternatif dengan Proses Karbonisasi dan Pembriketan.* Jurnal Rekayasa Proses Vol. 4. No.1. 2010.

[10] Hamidi, et al, *Pengaruh Penambahan Tongkol Jagung Terhadap Performa Pembakaran Bahan Bakar Briket Blotong (Filter Cake).* Jurnal Rekayasa Mesin, Vol. 2 No.2. 2011.

[11] Wijayanti, "Karakteristik Briket Arang dari Serbuk Gergaji dengan Penambahan Arang Cangkang Kelapa Sawit*",* Departemen Kehutanan, Fakultas Pertanian Universitas Sumatera Utara, Medan, 2009..

[12] Purnama, *Pemanfaatan Limbah Cair CPO Sebagai Perekat Pada Pembuatan Briket Dari Arang Tandan Kosong Kelapa Sawit.* Jurnal Teknik Kimia Vol 18. No.3, 2012.

[13] Yusuf, M, et al, "Use Of Palm Midrib (Elaeis Guineensis Jacq.) As Raw Material For Charcoal Briquette". Departement of Forestry, Faculty of Agriculture, University of Riau, 2011.

[14] Wilasita et al, "Pemanfaatan Limbah Tongkol Jagung dan Tempurung Kelapa Menjadi Briket Sebagai Sumber Energi Alternatif dengan Proses Karbonisasi dan Non Karbonisas*i*", Laboratorium Pengolahan Limbah Industri Jurusan Teknik Kimia FTI-ITS Surabaya, 2011.

[15] Lestari *et al*, *Analisis Kualitas Briket Arang Tongkol Jagung yang Menggunakan Bahan Perekat Sagu dan Kanji.* Jurnal Aplikasi Fisika Vol. 6. No. 2, 2010.

[16] Fauziah, N, Pembuatan Arang Aktif Secara Langsung dari Kulit Acacia Mangium Wild dengan Aktivasi Fisika dan Aplikasinya sebagai Absorben, [Skripsi] Departemen Hasil Hutan, IPB Bogor, 2009.

[17] Hartley, CWS, The Oil Palm (Elaeis guineensis Jacq), Third Ed 761p. Essex : Longman Scientific & Technical, 1988.

[18] Puspitasari E, "Karakteristik Biopelet Campuran Cangkang Dan Pelepah Kelapa Sawit*"*, Departemen Hasil Hutan - IPB Bogor, 2014.

[19] Nur MS, "Karakteristik Kelapa Sawit sebagai Bahan Baku Bioenergi" Insan Fajar Mandiri Nusantara, 2014.

[20] Grover, P.D. dan Mishra, S.K. "*Biomass Briquetting : Technology and Practices"*, Field Document No. 46, FAO-Regional Wood Energy Development Program (RWEDP) In Asia, Bangkok, 1996.

[21] Masturin,A, "Sifat Fisik dan Kimia Briket Arang Limbah Gergaji Kayu. [Skripsi] Fakultas Kehutanan, IPB Bogor 2002.

[22] Kementerian Energi dan Sumber Daya Mineral Indonesia, "Peraturan Menteri Energi dan Sumber Daya Mineral tentang Perhitungan Harga Jual Eceran Bahan Bakar Minyak, No. 4 tahun 2015.

[23] Widarti, *et al*, "Studi eksperimental Karakteristik Briket Organik dengan Bahan baku Dari PPLH Seloliman", Teknik Fisika ITS Surabaya, 2007.