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The Potential of Bio-try Briquettes for Biomass Power Plant in Aceh Province – Case Study in South West Aceh, Indonesia

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ABSTRACT

Oil palm waste in the South West Aceh, Indonesia region, has the potential for renewable energies to replace fossil energy. On the basis of previous studies, the mixture of EFB, fiber and shells into bio-try briquettes had an average calorific value of 5000 calories per gram. In this study, the authors explored the potential of bio-try briquettes. Especially for the South West Aceh (Barsela) Region, a Bio-try briquette can generate electricity of 586.152 GWH, meet electricity consumption in Barsela of 584.57 GWH, and electricity surplus of 1.582 GWH. On the basis of the economic feasibility analysis, it was demonstrated that the Internal Rate of Return (IRR) is 22.58%, which surpasses the set interest rate of 12%, the net profit (NBC ratio is 34.39 > 1), and the principal return point (BEP) is below 1 year (< 0.034 years). As for the environmental aspect, the solid waste used can be reduced by 10.94% or 100800 tons per year. The environmental impact caused by the presence of bio-try briquette on the global warning potential (kg CO_2 eq) or greenhouse gases on the third mixture of waste is 77,000 kg per day or 77 tons per day.

Keywords: solid waste, bio-try briquette, power generation, electricity.

INTRODUCTION

The use of fossil fuels, which is increasing along with population growth and industrial growth, encourages an idea to explore and develop the potential of alternative renewable energy sources. It is driven by the depletion of fossil fuel reserves. Renewable energy is defined as energy obtained from sources or materials in which procurement and refurbishment (renewal cycle) does not require a long time. Meanwhile, non-renewable energy is the energy obtained from sources that are scarce or depleted and cannot be renewed (Alternatif 2007). According to (Alternatif 2007), Indonesia has renewable energy potential of 311 232 MW, but only 22% has been utilized. The potential of renewable energy which has not been widely utilized is biomass energy. One of that alternative energy sources corresponds to briquettes. Briquettes have large biomass energy and have not been widely used. Briquettes are solid fuels with a high calorific value and one of the renewable alternative fuels, apart from solar energy, wind energy, and water energy. On the basis of the SNI Standard, the briquettes have calorific value around 5 000 cal/gr (Alternatif 2007). One of the potential materials to be used as briquettes is solid waste from oil palm mill.

Oil palm is one of the commodities that is developing rapidly due to high fruit production and the promising sale of palm oil to lift the economic conditions of the community. Utilization of palm oil waste is an alternative substitute for coal, petroleum, and gas, which is estimated to run out after 50 years, so that humans will exploit the potential of palm oil waste to obtain electricity in the future (Bantacut and Novitasari 2016). One of the potential sources to develop is an oil palm plantation located in the Southwest region of Aceh (Barsela), with a palm oil mill with a production capacity of 30–60 tonne per hour of Fresh Fruit Bunches (FFB). The processing of palm oil used FFB as raw material that produced Crude Palm Oil (CPO) and Palm Kernel Oil (PKO) as the main product, and by-product in the form of solid and liquid waste. The by-products are solid waste in the form of empty fruit bunches (EFB), fiber and shells, and POME (*Palm Oil Mill Effluent*) as liquid waste (Foo and Hameed 2010), (Abdullah and Sulaim 2013)**.**

Previous research showed that for the FFB production capacity of 45 tons per hour and the production time of 24 hours per day, it produces 11.8% shell, 10.62% fiber, and 43.24% liquid waste, while the remaining 34.34% is lost during the process. It can be used as electrical energy, and 20.94% is lost during the boiler process (Kamahara et al. 2010). To calculate the energy potential of the 16 Palm Oil Mills in Barsela, one can refer to the respective percentages of 13% fiber, 7% shell, and 20% oil palm EFB for every 1 tonne of FFB (Nasution et al. 2014)**.** This study aimed to determine the potential utilization of solid waste from processing palm oil into bio-try briquettes and the availability of energy for the development of the resulting power plants (Fauzianto 2014).

METHODOLOGY

Production data of oil palm mill was obtained and analyzed to determine the potential of solid waste from palm oil to become a bio-try briquette, and the potential of energy that is generated by using Bio-try briquette as fuel in Power Plant.

Date and place

The Palm Oil Industry in South West Aceh was divided into three regions: Aceh Jaya Regency, West Aceh, and Nagan Raya. Each region has a palm oil mill processing industry. There was one palm oil mill in Aceh Jaya, 3 palm oil mills in West Aceh, and 12 palm oil mills in Nagan Raya; in contrast, there are no palm oil mills in Southwest Aceh. In general, the operated palm oil mills in respective regions had a mill processing capacity of 30 tons per hour, 60 tons per hour, and less than 30 tons per hour. Primary and secondary data collection methods were used through Fresh Fruit Bunch and personal interview of stakeholders including local community, specifically oil palm farmers, government and factory workers. Total number of respondents equals 139, distributed among oil palm farmers, oil palm factory workers, oil palm plantations, electricity companies and other relevant experts. The total number of respondents was 139, consisting of oil palm farmers, oil palm factory workers, oil palm plantations owner, electricity companies and other relevant experts. To find the suitable method for developing this research, the authors referred to the studies that have been done with respect to utilization solid waste of oil palm mill as briquettes.

The analysis amount of solid waste produced in south west of Aceh

Oil Palm Company with production capacity of 30 tonnes/hour was used as the research object based on the average production capacity of palm oil mill. The conversion factor of production ($C\%$) is around 80%. The operating time (T_{prod}) each palm oil mill is 20 hours each day. The amount of solid waste (Ftw) can be calculated using this formula:

$$Ftw = Fffb \times C\% \times Tprod \quad (1)$$

The waste of oil palm mill consist of EFB (W_{efb}) 20% w/w; fiber (W_{fiber}) 13% w/w; and shell (Wshell) 7% w/w. To calculate the amount of each solid waste, the following formula can be used:

$$F_{efb} = Ftw \times W_{efb} \quad (2)$$

$$F_{fiber} = Ftw \times W_{fiber} \quad (3)$$

$$F_{shell} = Ftw \times W_{shell} \quad (4)$$

The analysis of potential method to produce bio-try briquettes based on previous research

To find the best and appropriate method, it is important to consider the previous research. In this research, the previous studies about briquette and the utilization of oil palm were used as references.

The analysis of total energy that will be generated by using bio-try briquettes

To calculate the total energy that will be generated, the assumption is needed. The value of maximum briquette conversion (CB%) and the composition of mixed component referred to previous research. To obtain the total energy of a briquette, the amount of briquettes produced (Fb) is needed. The equation (5) used to obtain the amount of briquettes produced and equation (6) for calculating total energy (THVday).

$$Fb = CB\% \, x \, (Fshell + \frac{1}{2} Fshell + \frac{1}{1} Fshell) \quad (5)$$

In this research, shell is used as a limiting reagent. The composition of 1:2:2 (w/w) was used. The total energy generated by a briquette (THV) in kW can be calculated by multiplying amount of briquette with calorific value of a briquette (HHV), total operating day for one year and conversion value.

$$THV = HHV \times Fb \times 0.00163 \quad (6)$$

Analysis of economic feasibility of bio-try briquette development

To analyze the economic feasibility of the implementation of this bio-try briquette, the comparison of the use of coal power plants in the Barsela region is performed. Assuming the energy surplus of the only income of the implementation of bio-try briquettes and assumes the cost of planting and operational incorporations borne by electrical energy sales according to the needs of Barsela, the economic feasibility can be analyzed by the following equation:

$$NPV = (C_t \times PVIFA(r)(t)) - C_0 \quad (7)$$

$$IRR = Ir + \frac{NPV\ Ir}{NPV\ Ir - NPV\ It} * (It - Ir) \quad (8)$$

Analysis of environmental impact of Biotry Briquette development

To conduct an analysis of environmental impact of bio-try briquette development, a calculation of reducing the amount of solid waste disposed of into the environment along with aspects of CO_2 production was conducted. For the aspect of reducing the amount of solid waste, a comparison was made between the difference between the total amount of solid waste produced in the Barsela area and the amount of bio-try briquettes produced (as a representation of the reduced amount of solid waste) to the total amount of solid waste produced.

$$F_{red} = F_{tw} - F_b \quad (9)$$

For the CO_2 production aspect, the equivalent mole is 1 (between bio-try briquettes and CO_2 in the process of a biomass power plant). The CO_2 production can be calculated using the following equation:

$$FCO_2 = eqv \times \frac{Fb}{Ar\ C} \times Mr\ CO_2 \quad (10)$$

RESULTS AND DISCUSSION

Analyzing the energy potential from biomass is very important to solve the energy problems in Indonesia. Especially, as an effort to replace the use of fossil energy which is currently still the main energy in Indonesia. Bioenergy, as an alternative to renewable energy, can meet the need for energy both in the world and Indonesia, especially in this study focused on the southwest region of Aceh (Barsela) (Fauzianto 2014; Embrandiri et al. 2012; Agustiar et al. 2020).

The potential of the Barsela Region for utilizing briquettes from solid waste of oil palm mill

This research was conducted in four regions in the southwest of Aceh, namely Aceh Jaya, West Aceh, Nagan Raya, and Southwest Aceh. In these four areas, an analysis was carried out related to the potential for oil palm plantations, oil palm mill operating in the area, as well as the energy consumption needs in the area. From the data obtained, oil palm mills are only scattered in three regions, namely Aceh Jaya, West Aceh, and Nagan Raya areas. The number of factories for each region as follows: one factory in the Aceh Jaya area, three areas in the West Aceh area, and 12 factories in the Nagan Raya area. In general, an operating palm oil mill has a production capacity of 30 tones/hour, 60 tones/hour, and less than 30 tones/hour. Table 1 presented the data number of factories for each production capacity (Agustiar et al. 2020).

The raw material for oil palm processing is supplied from oil palm plantations in the Barsela area. Table 2 shows the distribution area of oil palm plantations and the total oil palm produced. According to Table 2, it can be seen that the Nagan Raya area dominates the total area of oil palm plantations by 74.54% of the total oil palm plantations in the Barsela area. Meanwhile, the regions of Aceh Barat, Aceh Jaya, and Aceh Barat Daya have a percentage of oil palm plantation area of 8.95%; 7.59%; and 8.92%, respectively. With the largest percentage of oil palm plantations, the

Nagan Raya area also has a high level of oil palm productivity, which is 65.03% of the total oil palm production in the region. Then, the regions of West Aceh, Aceh Jaya, and Aceh Barat Daya have a production percentage of 8.95%; 7.59%; and 8.92%, respectively.

From the data in Table 1, for this study, it was assumed that the average production amount of oil palm processing mill in the Barsela region is 30 tonnes/day. This is based on the capacity of 30 tonnes/hr representing 70% of the total mill in the Barsela region. Furthermore, the estimation of the amount of solid waste produced by palm oil processing plants in the Barsela region can be calculated using Equations 1, 2, 3, and 4. Table 3 describes the total solid waste generated.

For a sample of one factory with a capacity of 30 tonnes/day with a conversion factor of 80% and a production time of 20 hours/day, the resulting waste is 480 tonnes/day (Silvestre et al. 2014). This waste consists of solid waste in the form of EFB, fiber, shell, and liquid waste in the form of POME. The percentage of EFB, fiber, and shell in palm oil processing waste is 20% (w/w) for EFB; 13% (w/w) for fiber, and 7% (w/w) for shell (Nasution et al. 2014; Rahayu et al. 2018). Thus, the following amount of EFB, fiber, and shell waste is obtained: 96; 62.4; and 33.6 tonnes/day, respectively (Embrandiri et al. 2012).

With the data on the amount of solid waste produced, the estimated briquette produced can be calculated using equation (5). On the basis of previous research, the maximum conversion of lignocellulosic material to charcoal briquettes is 25% (w/w). Therefore, in this study, the conversion value is assumed to be 25%. It was found that the total briquette produced in the Barsela region was 21 tonnes/day.

Table 1. The distribution of oil palm mill based on production capacity [Bantacut et al., 2020]

Capacity (ton/hr)	Palm oil mill (unit)	Percentage (%)
Smaller (<30)	4	25
30	11	67
60	1	8
Jumlah	16	100

Tabel 3. Estimated of total amount of each form solid waste

No	Solid waste	Total amount (ton/day)
1	EFB	96.0
2	Fiber	62.4
3	Shell	33.6
Total solid waste		192.0

The approach of utilization of palm solid waste as briquettes

Oil Palm Mill solid waste is a lignocellulose material that is used to produce briquettes. By seeing the vast potential of the Barsela region in producing solid waste from Oil Palm Mill, Utilization solid waste into briquettes is deemed necessary to reduce the negative impact of waste disposal as well as to meet energy needs in the Barsela region. Several studies have been conducted by researchers to look at the utilization of palm oil waste into briquettes. Some of them are research conducted using a mixture of shell and EFB of oil palm with a 1: 2 ratio and 20% adhesive to produce briquettes with a calorific value of 6181.68 cal/gr. Meanwhile, in a study conducted (Susanto and Yanto 2013) using a 1:20 ratio of shell charcoal: EFB, and adhesive concentration of 2%, briquettes with a calorific value of 5069 cal/gr were produced. However, these studies are limited to only one component of solid waste or two-component of solid waste. In addition, the research on the potential of three solid wastes to combine into briquettes is deemed necessary. Figure 1 shows a flow chart for the utilization of briquettes from solid waste of Oil Palm Mill.

Table 2. The distribution of oil palm plantation and its production capacity [Bantacut et al., 2020]

No	Region	Area (ha)	Production (tonnes/ha)	Comparation	
				Area (%)	Production (%)
1	Aceh Jaya	19643	149515	7.59	6.70
2	West Aceh	23161	335680	8.95	15.03
3	Nagan Raya	192931	1452047	74.54	65.03
4	Southwest Aceh	23089	295557	8.92	13.24
	Total	258824	2232799	100.00	100.00

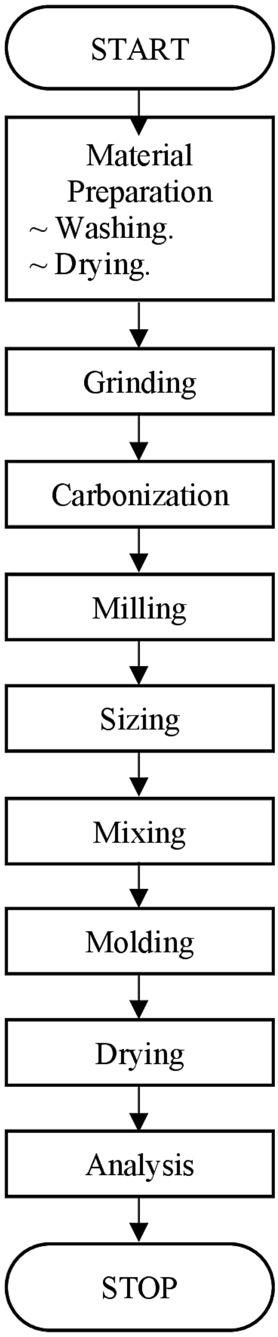

Fig. 1. Flowchart bio-try briquette

Material treatment

The raw materials used in this study are solid waste from oil palm mills, which consists of fiber, shells, and empty fruit bunches from the Barsela region. Material treatment consists of a washing and drying process. The washing process is carried out to remove impurities such as soil, which are present in raw materials. Washing is done by immersing solid waste in the water. After washing, the raw materials are then dried by storing them in an open space exposed to sunlight (temperature range 35–50 ^{o}C). Drying is carried out for 12 hours in the sun.

Grinding

Grinding is the process of reducing the particle size of processed materials from large/coarse shapes to smaller sizes. The raw materials that have been through the washing process are then carried out by size reduction by chopping them until the raw materials have dimensions less than 10 cm in length. Grinding is done using a grinder. For the materials that are still above 10 cm, grinding will be carried out again.

Carbonization

The carbonization or charcoal process is the heating process at a certain temperature of organic materials with a very limited amount of oxygen. The purpose of carbonization is to remove volatile matter contained in the base material. This process causes the decomposition of the organic compounds that make up the structure of the material to form water, acetic acid vapor, tar, and hydrocarbons. Charcoal making or carbonization is carried out separately for the three raw materials using kerosene drums. The time required for the carbonization of the three materials is around 1 day. Charcoal is done in a closed space to reduce the amount of oxygen that enters the drum. The drum is given 4 holes with a diameter of 2.5 cm which aims to release the smoke produced. Before cooking, the bottom of the drum is given fuel in the form of kerosene as a trigger to facilitate combustion. During carbonization, it is necessary to pay attention to the smoke that is formed. If the smoke is thick white, it indicates the shell is drying. If the smoke is thick and yellow, this indicates carbonizing is taking place. In this phase, the furnace should be closed with the intention that oxygen in the coking chamber is as low as possible so that good charcoal results are obtained. If the smoke is becoming thinner and blue, it means that the charcoal is almost finished. The charcoal is stopped by sprinkling a little water into the drum to prevent the charcoal from turning to ash. Then, it is necessary to wait for the charcoal to cool. After that, the charcoal can be unloaded, taken and dried.

Milling

The solid waste charcoal was then crushed using a ball mill until powdered charcoal was obtained. This process is necessary because it

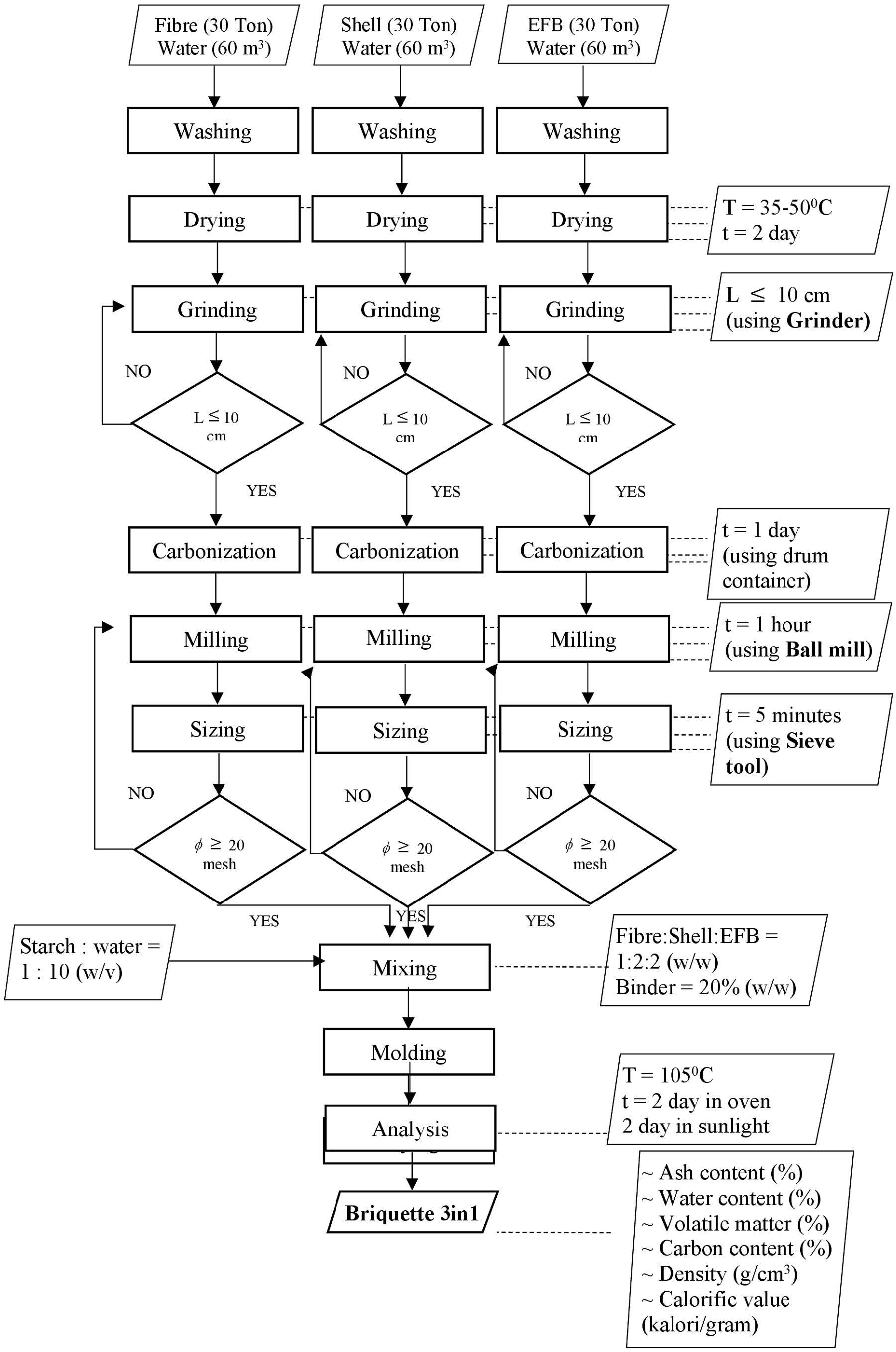

Fig. 2. Process flow briquette biotry

affected the mixing process that will be carried out by adding a binder to the mixture of 3 charcoal powders. The milling process was carried out for 1 hour for each cycle.

Sizing

The charcoal powder that was milled is then sieved using a sieve vibrator. The sizing process was done until the powder size of 20 mesh. The size uniformity as carried out to achieve the similarity of components and characteristics.

Mixing

The charcoal powder of 3 solid waste materials was sieved, then it was mixed evenly with the ratio EFB: fiber: shell = 1: 2: 2. The mixture of EFB, shell, and fiber charcoal was added with adhesive from starch, in an amount of as much as 20% of the total mixture of EFB, shell, and fiber charcoal. For example, the ratio of the mixture of EFB, shell, fiber, and adhesive mixtures for one briquette mixture is 1 kg EFB charcoal, 2 kg shell charcoal, 2 kg fiber charcoal, and 1 kg adhesive (starch).

Molding

The charcoal mixture was mixed with adhesive then it was placed into a mold made of steel, which is molded using a hydraulic press with a pressure of 2721.6×10^3, N/m^2 with a pressing time of 5 minutes**.**

Drying

The briquettes have been formed then those are dried in the oven for 2 days (24 hours). After that, the briquettes were dried under the sun for 12 hours. After the completion of the drying process, it was held down, and then a briquette analysis was performed.

Analysis

Six parameters were used as quality standards for the briquettes produced. The six parameters included ash content (%), water content (%), volatile matter (%), carbon content (%), density (gr/cm^3) and calorific value (calories/gr). The analysis method used is based on SNI 01-6235-2000. The briquette standards according to SNI 01-6235-2000 can be seen in Table 4.

Table 4. Commercial briquette standard [Darvina dan Asma, 2011]

Parameter	Value
Ash content (%)	8
Water content (%)	8
Volatile matter (%)	15–25
Carbon content (%)	78.35
Density (gr/cm^3)	0.447
Calorific value (kalori/gr)	5000

The potential of energy generated by Briquettes as a biomass power plant in the Barsela Region

The use of electrical energy in the Barsela region is classified into two types, namely regular use for households and industry use. In Table 5, the total annual consumption of electrical energy in the Barcelona region is presented:

The use of electrical energy for the West Aceh, Nagan Raya, Aceh Jaya, Southwest Aceh and industries in the South West Aceh (Barsela) region is not or very large. The largest average use of electricity consumption is in the Naga Raya area of 193.355 MW or 33.08%, West Aceh 182.306 MW equivalent to 31.19%, Aceh Jaya 119.581 MW equivalent to 20.46%, Aceh Barat Daya 87.031 MW equivalent to 14.89%, and industrial use is very small for this region, around 2304 MW which equivalent to 0.39% (Table 5). By using equations (6), (7), and several value assumptions such as the calorific value of the briquette produced of 5.000 Cal/gr (based on the standard of commercial briquette), the amount of energy that can be generated from using briquette to produce electrical energy is 586.152 GWH. The comparison of demand and supply of electrical energy in Barsela with the use of briquettes from solid waste oil palm was described. Figure 3 shows that the utilization of solid waste from palm oil into briquettes can meet the demand for electrical energy in the Barsela region. Moreover, there is an energy surplus of 1,582 GWH, based on the existing electricity consumption data.

Table 5. Electricity consumption in one year for each sector and district in Barsela

No	Sector/District	Electricity consumption for 1 year (MW)
1	Aceh Barat	182306
2	Nagan Raya	193355
3	Aceh Jaya	119581
4	Aceh Barat Daya	87031
5	Industrial	2304
Total		584577
		584.57 GW

The development of Bio-try briquette is a necessity in the future due to its high energy potential. Research on the use of EFB, fiber, shells has been conducted, a mixture of EFB and shells into electrical energy has been studied by (Susanto and Yanto 2013). For the mixing of three solid wastes into biomass electrical energy, this research was conducted in the Barsela area. This research, as well as a research that can provide the potential for electric energy in the future as an alternative to replace the use of fossil energy after its lifetime has not been carried out previously.

Economic feasibility analysis of bio-try briquettes

The economic feasibility analysis was carried out to see the economic benefits of the application of this research. Of course, besides being able to replace a technology in use, it also has a positive economic impact on its application. In

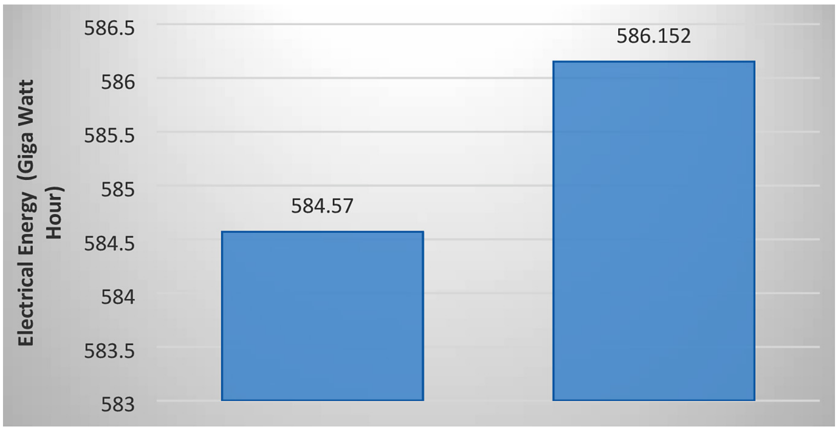

Fig. 3. Electricity need from bio-try briquette in Barsela

conducting an economic feasibility analysis, the researchers made several assumptions, including: a) The author assumes that the costs for the establishment of the factory and operations (such as the cost of electricity for the operation of the Power Plant, Wages for Workers, Insurance for Workers, etc.) are met by the sale of electricity for a number of electricity needs in the Barsela area (584,57 GWH), b) The author assumes that the profit from the application of this technology is obtained from the sale of electrical energy with a surplus of 1,582 GWH (derived from the amount of bio-try briquette electricity 586,162 GWH minus the electricity demand in the Barsela area of 584,57 GWH); c) The author assumes the costs that must be incurred for the application of this technology come from the cost of purchasing the machine and its maintenance. Table 6 shows the cost of procuring the bio-try briquette making machine and Table 7 shows the maintenance costs of the machine. By considering the three assumptions above also using equations (7) and (8) it is obtained that an Internal Rate Return (IRR) of 22,58% is greater than the current interest rate of 12%, a Net Benefit-Cost ratio (NBC ratio) of 34,39 (>1), and a Break Even Point (BEP) under 1 year (<0,03 years). Referring to the three parameters above, this technology is categorized as feasible to be developed. Table 8 shows the economic parameters of this technology.

Table 6. Machine purchasing cost

No	Machines	Price per unit (IDR)	Total unit	Total price (IDR)
1	Carbonization drums	250 000	10	2 500 000
2	Grinder	50 000 000	2	100 000 000
3	Ball Mill	50 000 000	2	100 000 000
4	Sieve Tray	20 000 000	2	40 000 000
5	Oven	20 000 000	4	80 000 000
Total				322 500 000

Table 7. Machine maintenance cost

No.	Machine	Total price (IDR)	Value (%)	Cost (IDR)	Maintenance cost (IDR)					
					2021	2022	2023	2024	2025	2026–2040
1	Carbonization drum	250 000	1%	25 000	25 000	25 250	25 750	25 500	26 000	26 250
2	Grinder	10 000 000	1%	1000 000	1000 000	1010 000	1020 000	1030 000	1040 000	1050 000
3	Ball mill	10 000 000	1%	1000 000	1000 000	1010 000	1020 000	1030 000	1040 000	1050 000
4	Sieve tray	4 000 000	1%	400 000	400 000	404 000	408 000	416 000	412 000	420 000
5	Oven	8 000 000	1%	800 000	800 000	808 000	824 000	816 000	832 000	840 000
Total		32 250 000	1%	3225 000	3225 000	3257 250	3297 750	3317 500	3350 000	3386 250

Table 8. The value of each economical aspect

No	Parameter	Value	Note
1	IRR	22.582%	More than IRR (IRR > 12%)
2	Net BCR	34.39	More than (Net BCR>1)
3	BEP	0.0343 year	Less than 1 year (BEP < 1)

Table 9. Solid waste reduction by applying this technology

Parameter	Value	Unit	Note
Total of waste	192	tonnes/day	everyday 1 factory
	3072	tonnes/day	everyday 16 factory
Total of bio-try briquette	21	tonnes	everyday 1 factory
	336	tonnes	everyday 16 factory
Total reduction	10.9375	%	

Table 10. CO_2 production by applying this method

Parameter	Amount	Units
Total biotry-briquette	21	tonnes/day
	1750	kg/kmol
Total CO_2 generated	77000	kg/day
	77	tonnes/day

Feasibility analysis of bio-try briquette environmental impact

The environmental impact feasibility analysis was carried out to see the extent to which the application of this technology could have a positive or negative impact on the environment (Balat and Balat 2009). In this study, the authors limit the analysis to two things, namely: aspects of reducing the amount of solid waste disposed of into the environment along with aspects of CO_2 production (Malek et al. 2016), (Cherubini et al. 2009), (Jaye et al. 2016). For the aspect of reducing the amount of solid waste, a comparison is made between the difference between the total amount of solid waste produced in the Barsela area and the amount of bio-try briquettes produced (as a representation of the reduced amount of solid waste) to the total amount of solid waste produced. By using equation (9), the following data were obtained.

By applying this technology, the solid waste from the Oil Palm Mill in the Barsela Region can be reduced by 10.9375% or as much as 100 800 tonnes for one year (Table 9). For the CO_2 production aspect, the equivalent mole is 1 (between bio-try briquettes and CO_2 in the process of a biomass power plant). Thus, the amount of CO_2 production can be calculated using equation (10). Table 10 shows that the CO_2 produced from the use of bio-try briquette as fuel for the biomass power plant is 77 tonnes/day, with total bio-try briquette is 21 tonnes/day or 1.750 kg/kmol.

CONCLUSIONS

On the basis of the research, it can be concluded that assuming a FFB of 30 tones/hour, with 16 operated Palm Oil Mill and a calorific value of 5.000 calories/gram, bio-try briquettes can generate electrical energy of 586,152 GWH. When compared with the demand for electrical energy in the Barsela region, there will be a surplus of 1,582 GWH. To provide for the need of electricity in Barsela region, 16 operated Palm Oil Mill with production capacity 30 tones/hour are required to substitute the Coal Power Plant. Assuming a surplus of electrical energy as the advantage of using Bio-try briquettes, with a surplus of energy of 1,582 GWH in a period of 20 years, the required BEP is less than 1 year and an IRR of 22,58%. The Bio-try briquette energy needs in the area Barsela can have a positive effect on the availability of electricity, preventing shortage of electricity in the future. The excess electrical energy of Bio-try briquettes can be projected for the benefit of industry, plantation and for the benefit of regions / areas through the process of replacing coal on bio-try briquette for national interests. Excess energy surpluses obtained for the fulfillment of the energy is in the 4 regions, can also be designated for interest in the Aceh region and also outside the region of Aceh. By considering the advantages and benefits derived from bio-try briquette production, the authors recommend a few things,considering the potential of Barsela Region, the authors highly recommend to scale up this research into industry scale. The advanced research about the potential of liquid waste (POME) from Oil Palm Mill is required. Considering the condition of electricity supply in the Aceh region, which is highly dependent on the Sumbagut area, implementing this idea can make energy independence for the Aceh region, especially the southwest region, as a target for the establishment of factories and suppliers of main raw materials. A positive impact on the reduction of CO_2 caused by the burning of coal for the environment in the region Barsela includes reducing global warning potential (GWP), reduce the accumulation of solid waste oil palm industry in the region Barsela and replacement of coal, which contribute to pollution and generation of coal ash causing highly disturbing environmental impact in the Barsela region.

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