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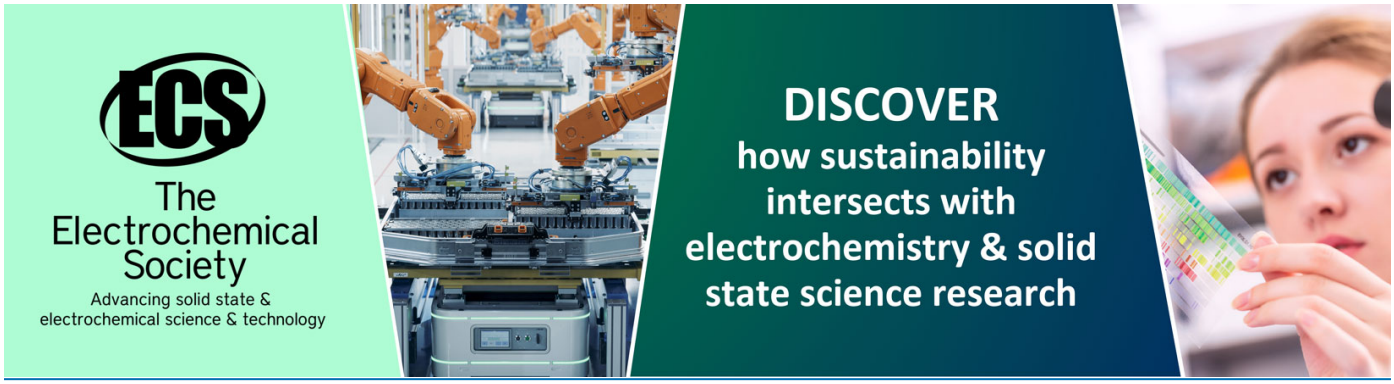

Biomass analysis at palm oil factory as an electric power plant

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Abstract. Biomassa found in palm oil mill industryis a by-product such as palm shell, fiber, empty fruit bunches and pome. The material can be used as an alternative fuel for fossil fuel. On PTPN IVpalm oil millDolokSinumbah with a capacity of 30 tons tbs/hour of palm fruit fiber and palm shells has been utilized as boiler fuel to produce steam to supplyboilers power plant. With this utilization, the use of generators that using fossil fuel can be reduced, this would provide added value for the company. From the analysis, the fiber and shell materials were sufficient to supply 18 tons/hoursteam for the boiler. Shell material even excess as much as 441,5 tons per month. By utilizing the 2 types of biomass that is available alone, the electricity needs of the factory of 734 Kwh can be met. While other materials such as empty bunches and pome can be utilized to increase the added value and profitability for the palm oil mill.

1. Introduction

Biomass is an organic material made from plants and animals. Biomass contains stored energy derived from the sun. Plants absorb solar energy in a process called photosynthesis. Chemical energy in plants will be passed on to animals and people who eat them[2]. Indonesia has great potential to utilize biomass from palm oil by-products as an alternative fuel source. Indonesia's palm oil is one of the fastest growing commodities. Increasing the area of oil palm plantations has encouraged the growth of processing industries, including palm oil mills that produce crued palm oil (CPO).Palm oil mill is an industry loaded with processing residues. Palm oil mill only produces 25-30% of main products in the form of 20-23% CPO and 5-7% of palm kernel. While the remaining 70-75% is waste that can be classified into three groups namely liquid waste, solid waste, and gaswaste. The amount of solid waste produced by the palm oil processing mill ranges from 40 - 41% of every ton of processed palm.[3]Palm oil mill waste is actually a component of pollutants, but it can be usedas a source of electrical energy.

2. Palm Oil Mill Electricity Needs

The processing of palm oil into CPO is through several stages that require the consumption of electrical energy. The greater the production capacity, the complexity of processes and automation, the consumption of electrical energy in need is higher. The general parameters of power consumption in the palm oil factory are 17-19 Kwh/ton TBS. Ideally palm oil mills are able to independently meet their energy needs. Fiber waste and palm shells can be used for boiler fuel as a steam generator used for turbine power generation, as well as a steam source for boiling and processing.

The energy source installed at the palm oil mills with a capacity of 30 tons/ hour is 2 (two) generators with power 400/500(Kw/KVA), 1 (one) 200 kW genset and 2 (two) steam turbine

generators each with a power of 800 kW and 742 Kw/816 Hp that can operate alternately or together.[1] A 200 kW power generating set is operated to supply domestic and lighting the needs when the plant is in an inactive state and the turbine is not working yet.[5]Generator with 2 x 400 kW capacity is operated for ignition and the factory's first process until the factory produces fiber and shell for boiler fuel and the boiler capable of producing steam with capacity expected to drive steam turbine to produce electrical energy continuously.

Turbine can operate normally if steam pressure is around 18-21 bar. If the boiler's working pressure shows a downward trend of up to 15 bar then the turbine can not be burdened for the factory process and then there will be trip, so to keep the process does not stop abruptly, the engine room operator immediately activate the 400 kw generator to be in sync with turbine. [4] If this situation often occurs the consequence is the increase in operational costs due to the use of diesel fuel and the increase of bollieropratordifficultybecause he must immediately shoveling fuel into the boiler furnace to increase combustion heat and increase the steam pressure that should be enough in the supply of fuel feeding conveyor.

3. Electrical Energy Consumption

To know the characteristics and usage of the electrical load, can be read with measuring device that mounted at engine room panel in the form of kW-meter and amperemeter. While the electrical energy used is measured through the kWh-meter contained in each of the plant's panels. Loads will fluctuate and adjust the power requirements of the engine or electricity used by each unit. The use of electric power for processing is more dominant by 77.62%. Domestic loads came in second place at 16.75%. While other expenses such as head office, mill office, Workshop, and street lighting have small values ranging from 0.5 to 3%. So the use for this load does not have a big effect on the power that is borne against the plant [6].

The domestic electrical load is large enough to contribute to the usage of electrical power. The use of electrical power from this domestic load is borne by the palm oil processing indusry so that the calculation of the consumption of electrical energy against the Kwh/ton TBS will also be affected.

In actual conditions for domestic loads, the average electricity usage is recorded in an average at 17.30-21.00. This happens because the time is a break time and most people tend to use electricity to turn on the house lights, watch television or other devices that require electricity. As for the processing in the factory operating conditions remain stable. The difference in the electrical power at the factory is used for lighting loads. Safety on domestic panels is used to meet the domestic load. When one power distribution line is done to the office and housing, the domestic auto panel should not be turned off.

4. Research Metodology

This research was done like this flow chart below:

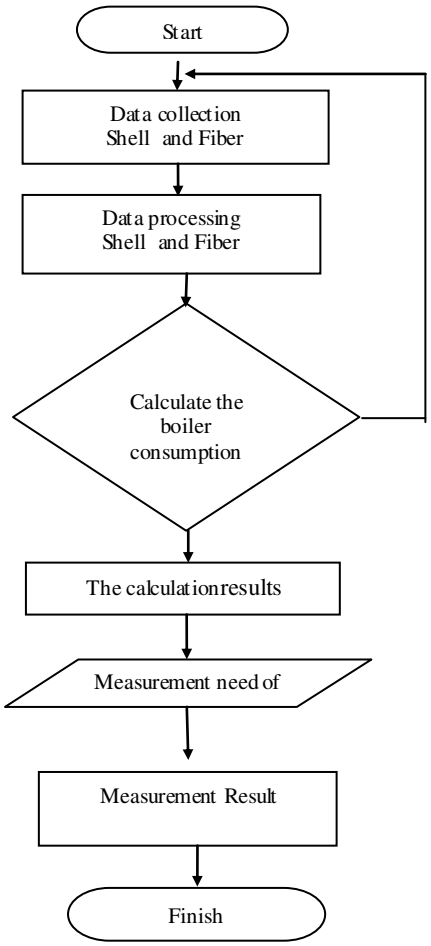

Figure 1. Flow chart of research path.

5. Biomass Utilization

The amount of biomass that is by-product of palm oil mill can be seen through Table 2 below:

Table 1. Electricity consumption of palm oil mill 30 Ton TBS/Hour. **

No.	STATION	INSTALLED		OPERATING		Df (%) *)
		(Kw)	(A)	(A)	(Kw)	
1.	Reception & Sterilizer	147	279	175	92	63
2.	Threshing	149	283	88	46	31
3.	Pressing	240	456	200	105	44
4.	Clarification	171	325	30	16	9
5.	Oil Storage	23	44	12	6	27
6.	Depericarcarper& Kernel	281	534	280	147	52
7.	Boiler Control	230	437	320	168	73
8.	WTP	193	367	63	33	17
9.	Boiler Demint	76	144	20	11	14
10.	Effluent Treatment	60	114	45	24	31
11.	Factory Lighting	75	142	50	26	35
12.	Domestic Lighting	50	95	40	21	42
13.	Street Lighting	53	100	55	29	54
	Total	**1748**			**734**	**42**

*) Df = Demad Factor

**) Source :Factory

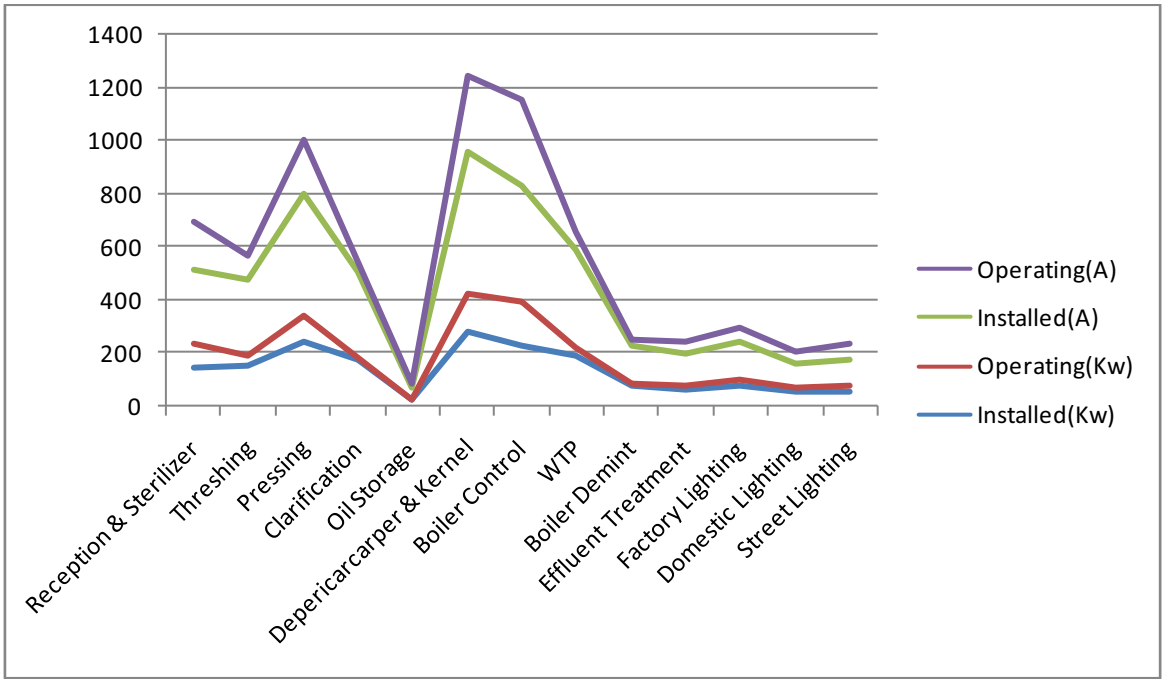

Figure 2. Electricity consumption of palm oil mill 30 Ton TBS/Hours.

Table 2. Biomass of palm oil mill.

No.	Biomass	Form	Sum*)	Calori (Kcal)**)
1.	JanjangKosong	Solid	22 – 23%	4492/kg
2.	Serat (Fiber)	Solid	12 – 14%	2637 – 4554 /kg
3.	Cangkang (Shell)	Solid	6- 8%	4105 – 4802/kg
4.	POME	Liquid	2 ton	4695 – 8569 /m3

*). Percentage of TBS processed
**). 1 Kcal = 4.187 Joule = 1,163 wh
***) Ref.No[3]

In Dolok Sinumbah palm oil mill this is fit the biomass boiler specification materials used as fuel is fiber and shell.[5]

Table 3. Boiler Specification used by palm oil mill.

No.	Description	Simbolic	Spesifikasi
1.	Steam Capacity	(Q)	20.000kg/h
2.	Steam Temperature	(tu)	280° C S.H
3.	Steam Peassure	(P)	20 kg/cm²
4.	Bait water temperature	(ta)	90^0 C
5.	η Kettle= 73%	η	73%
6.	Fuel	Fibers	75%
		Shells	25%

The usage of steam for palm oil processing with Triple Peak System on Sterilizer = 0.6 tonnes of steam/ton of TBS, so that Total vapor required = 30 tons of TBS x 0.6 tonnes of steam/ton TBS = 18 tonnes of steam/hour.
The amount of fuel available on the palm oil mill with a capacity of 30 tonnes of TBS/hour is generated /hour each: [8]
- Fiber = 14% x 30 ton = 4,2 ton
- Shell = 8% x 30 ton= 2,4 ton

Heating value calculation for fiber material (N.O):
Composition
Water = 39,8% x 4200 Kg = 1670 gg
NOS = 55,6% x 4200 kg = 2340 kg
OIL = 4,65% x 4200 kg= 190 kg

Heating Value
NOS = 3850 Kcal/kg
OIL = 8800 Kcal/kg
Heat Evaporation Water = 600 Kcal/kg
NO fiber = [(2340 x 3850) + (190 x 8800) – (600 x 1670)]/ 4200 = 2305 Kcal/kg

Heating value calculation for shell materials (N.O):
Composition
Water = 23,5% x 2400 kg = 564 kg
NOS = 75,9% x 2400 kg = 1821 kg
OIL = 0,6% x 2400 kg = 15 kg
Heating Value NOS = 4700 Kcal/kg
OIL = 8800 Kcal/kg
Heat Evaporation water = 600 Kcal/kg

NO shell = [(1821 x 4700) + (15 x 8800) – (600 x 564)]/ 2400 = 3480 Kcal/kg
Steam production of all fiber fuels is 4200 kg
ηKettle = [Q (**Δ**Entalphy)] / Gbb x NO
0,73 = [Q (**710,9 – 90,03**)] / 4200 x 2305
Q = [(4200 x 2305) x 0,73] / 620,87
Q = 11383 kg steam/hour

(note on P = 20 kg/cm2 tu 280^0C entalphy = 710,9 and tu 90^0C entalphy = 90.03)

Shell fuel is needed to supply 18 tons of steam/hour

η Kettle = [Q (**Δ**Entalphy)] / Gbb x NO
0,73 = [Q (**710,9 – 90,03**)] / Gbb x 3480
Gbb = [(18.000 – 11.383) x 620,87] / (0,73 x 3480)

Gbb = (4.108.297) / (2,540,4)
Gbb = 1.517 kg

To meet the steam requirement of 18000 kg/hour, the available crane fuels are still excessive or left as much as = 2,400 - 1,517 = 883 kg or as many as 441.5 tons/month (20 hours work/day, 25 days per month).

6. Conclusion

The by-product of the palm oil processing mill is a biomass that can be used as an alternative to fuel oil. In DolokSinumbah palm oil mill with a capacity of 30 tons of TBS/h has used fiber and shells to heat the boiler as a steam generator that used to drive the steam turbines. The electricity generated is used to meet all electricity needs of 734 Kwh.

From the analysis result it still have got excess of shell fuel equal to 883 kg/hour after all the requirement of steam is fulfilled. Thus, this palm oil mill can use the biomass that it produces with a safe enough availability for all its electricity needs, besides there are still potential biomass that can still be utilized such as empty bunches and POME which is liquid waste. Other biomass ingredients can be used to gain added value to the company while increasing profitability. This article is expected to inspire and contribute to all existing palm oil factories in Indonesia so as to suppress the use of national energy in the use of fossil energy that is increasingly scarce, expensive and environmentally unfriendly.

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