

Optimalisasi Of Efficiency Terms And Test The Value Kalor Of Performansi Boiler Use The Energi Biomassa Upon Which Burn Alternative

Imam Kholiq, ST,MM ,Muharom,ST,MT

ABSTRACTION: Especial Fuel used [by] Boiler PG MODJO PANGGUNG TULUNGAGUNG PTPN X is bagasse, and oil burn the residu MFO. A lot of PG in Indonesia which exactly use the very costly fossil fuel, so that generate the inefisiensi. Research by enhancing fiber (cangkang + fiber + chaff), to (efficiency terms) performansi and performance of boiler PG MODJO PODIUM. Assess the kalor of every-every fuel calculated given the composition of every fuel by using existing equation from literature, calculation consume the fuel, space volume burn the, efficiency from every fuel to boiler and expense efficiency from every fuel used. From calculation of every fuel is hence got by result that, Fuel efficiency use the smaller dregs fuel compared to from fuel of fiber and oil burn the residu MFO. Later;Then from facetof material cost burn the bagasse more efficient from at fuel of fiber and oil burn the residu MFO. To reply the the problem hence researcher use the indirect method. This method own the advantage that is can know the balance of complete and energi substance to each;every stream, which can facilitate in identifying opdon to increase is optimal of efficiency of terms boiler.

Keyword: Boiler, Assess The Kalor of Fuel Biomassa, Boiler Efficiency, Alternative Fuel

1. INTRODUCTION

availability of Energi of world fossil will be non-stopped scarce progressively costly and. The circumstance will affect specially for sugar mill (PG) which dregs insufficiency still and burn the oil residu upon which burn the suplesi for the boiler of. To avoid the usage of oil residu, latter a lot of PG have coped to use the alternative fuel of like; wood, daduk and chaff (Biomassa). Exploiting of Biomassa of fiber and cangkang coconut in an optimal fashion very useful in matter of [is] make-up of efficiency terms of a [n] steaming kettle (boiler). At the moment fuel boiler [of] [at] Sugar Mill of Modjo Podium there [is] 3 fuel type in its combustion system, [is] first [of] fiber (cangkang + fiber + chaff), for the combustion of early, secondly bagasse (bagasse) used direct [at] furnace and thirdly residue oil used [at] burner boiler. Bagasse fuel represent the primary fuel. Bagasse or [is] as a rule referred [as] [by] bagase, [is] result from other side from process ekstraksi (pemerahan) of sugar cane dilution. Sugar Mill of Modjo Paggung yield the bagasse from sugar cane weight milled. Generally, sugar mill in Indonesia exploit the bagasse upon which burn for pertinent factory, after the bagasse experience of the draining. Dregs draining [done/conducted] by exploiting from machine mill extorting sugar cane which count have till rate irrigate and niranya decrease. One of potency energi which can be innovated [by] [is] energi biomassa of fiber waste + cangkang coconut, paddy chaff. During the time, coconut [of] a lot of used as [by] producer of vegetation oil without trying to find the potency owned [by] the coconut waste. waste of Coconut and paddy

generated by processing of coconut and paddy own the calorie content which high enough. If/When managed better waste of coconut and paddy serve the purpose of energi of substitution alternative petrify the embers which commonly use Power Station Steam Power (PLTU). Indonesia own the big potency to exploit.

2. BOOK STUDY

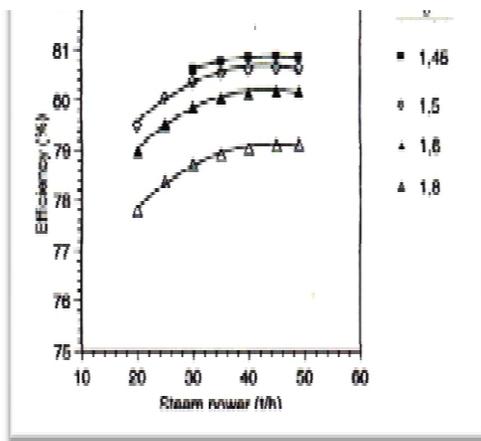
operational Boiler require the fuel which is quite a lot. So that expense released for the purchasing of the fuel become very high. So that the effort operational cost-saving require to be done for the minimization of expenditure. Various effort done to cost effective the fuel purchasing, among other things with the component addition to enlarge the efficiency boiler with the addition of fuel biomassa (paddy chaff, cakang + coconut fiber, baggase) fuel replacement from diesel oil (HSD) becoming residu and Biomassa. industrial Area Agro use the source of energi biomassa of coconut waste lock up the paddy, baggase. source of Energi biomassa used by come from solid waste of processing. The waste to be used as by boiler. In this shares is elaborated to hit the previous research is which have been done by either in home affairs and also beyond the sea. The research come from erudite research journal published by as according to science study which is discussed in by a research doneby researcher. Some research journal which have been publicized by for example :

- a. efficiency of Termis boiler defined by as energi (incoming panas) used effectively at vapour yielded. There are two method of study of efficiency boiler, that is by using direct method (direct method) and indirect method (indirect method). From obtained data sekunder, steaming kettle used [by] that is Takuma Water Tube Boiler Model the N.600 SA, with the fuel usage 75% for the fiber of (fiber) and 25% for the cangkang of (shell), efficiency boiler got [by] equal to 73% calculated to use the direct

- *Imam Kholiq ,ST,MM1) ,Muharom,ST,MT2)*
- *kholiqimam@gmail.com*
- *muharom@uwp.ac.id*

method (direct method). making weakness in evaluating efficiency boiler use the direct method is the method [do] not show promise about cause and various loss having an effect on in system. This matter push the researcher to check the the phenomenon use the indirect method (indirect method).

- b. Dalimunthe (2006) in its journal phrase that storey;level of efficiency of combustion of liquefied natural gas of boiler use the teared method equal to 71%. Compared to storey; level of efficiency boilerof above 80%, hence the boiler less be efficient. inefficient Boiler, possibility of because of big enough ekases air and also hot loss by gas throw away, for that efficiency boiler require to be improved again till reach the its efficiency [1]
- c. J. Barroso et al. (2003) dalam jurnalnya menyimpulkan tingkat efisiensi termal ampas tebu pada boiler yang dihitung menggunakan metode tak langsung dapat dilihat pada grafik dibawah ini :



Draw the 1. Fast Graph [of] mass flow condense to four ratio stoikiometrik (α_b) to efficiency of termis boiler.

For all analysed boiler, optimal value from this ratio stoikiometrik range from 1,5 and 1,55, to entire/all fast gyration of mass flow condense the, contrast with the ratio stoikiometrik used by before this research that is 1,8. This result is very making moderate of decision making by engineer and operator boiler, what can now easily control the boiler for the performance of optimal [2]. Heat which is passed to [by] fluid in boiler come from combustion process by assorted [of] fuel type which can be used, ligneous, coal, diesel fuel / petroleum, and gas. With the existence of technological progress, nuclear energy [is] also used as [by] a hot source at boiler. Burden of Sepesifik Space Burn : A lot of kalor discharged by association of space volume burn the time association (Qbb). (Btu / ft3 of clock or kkal / m3 clock) [1]. If fuel formation known, countable to hence sum up the requirement of combustion air for the combustion of perfect. [2]. Heat which is passed to by fluid in boiler

come from combustion process by assorted of fuel type which can be used, ligneous of batubara,solar / petroleum, and gas. With the existence of technological progress, nuclear energy is also used as by a hot source at boiler. Burden of Sepesifik Space Burn : A lot of kalor discharged by association of space volume burn the time association (Qbb). (Btu / ft3 of clock or kkal / m3jam) [1]. If fuel formation known, countable to hence sum up the requirement of combustion air for the combustion of perfect. [2] Indonesia as Agricultural country of a lot of yielding waste of agriculture and plantation which less be exploited by the example lock up the paddy and coconut coir. The waste represent the the biomassa represent the source of energi alternative. what is if processed by together with coal waste will become a[n] solid fuel of broader brand its use upon which burn the alternative of[is] so-called biobriket. Natural resources of Indonesia become the especial consideration convert the energi of oil and gas to biomassa. Biomassa represent the natural substance is which is usually considered to be a garbage and often annihilated by burned. It is important to know that Indonesia represent the biggest agricultural country to able to memasok of source of raw material biomassa, good from budidaya involve and also agriculture waste, ranch, and plantation. Where source of energi biomassa have the advantage for example :

- Source energi can be exploited continuously because in character which renewable resources
- Source energi relative [do] not contain the sulphur element, so that [do] not cause the air pollution as that happened [at] fossil fuel
- of Exploiting of energi biomass also improve the efficiency of exploiting of agriculture waste, ranch, and plantation

election of Waste of coir of coconut and paddy chaff as energi alternative caused by because this waste is very often thrown so that cause the environmental contamination. At factory of processing of solid coconut sawit waste of cangkang and coconut coir in the year 2004 reaching 5,47 million ton of while according to Winaya, (2008), Indonesia as agricultural country have about 60.000 machine of penggiling paddy which is gone the round of the totality area with the gyration produce the paddy chaff 15 million ton of per year, this prove that coconut coir and also lock up the paddy (it) is true very have potency [to upon which burn the alternative of while at especial permanent bottom ash upon which representing solid waste [is] rest of combustion from embers stone which still own the carbon content and assess the kalor. Kementrian Environment (2006) expressing that bottom ash of result of from grate system contain the fixed carbon with the calorie value of equal to 3000 kkal / singk.

3. RESEARCH METHODOLOGIES

3.1 Variable Taken

this examination is examination variable to get the value of kalor fuel that is high heating value (HHV)

And low heating value (LHV) Examination Procedure:

1. Cleaning tube bomb from rest of previous examination
2. Consider the fuel to be measured with the weighing-machine of equal to 0,15 gram 3. Measuring fuel volume
3. Preparing strand of metal for the penyala of by furling it and install it handle penyala attached [at] [cover/conclusion] bomb
4. Placing cup contain the fuel at the end of handle penyala
5. Closing bomb powerfully after attached by ring-O by turning around the cover
6. Filling Oxygen into bomb with the pressure 30 bar
7. Placing bomb which have been attached [by] into metre calorie
8. Including cooler water as much 1250 mL
9. Closing calorimeter with its cover
10. Animating churn irrigate the cooler of during 5 minute of before enkindling conducted.
11. Reading and noting temperature irrigate the cooler
12. Animating enkindling
13. Swirling cooler water of during 5 minute after enkindling take place
14. Reading and noting to return the temperature irrigate the cooler
15. Killing churn
16. Preparing to return the equipments for the examination of hereinafter
17. Reenacting measurement as much 5 multiply the berturut turut to an fue which is test measure. Result of examination is price average from fifth result of measurement.

3.2 Population and Sampel

Population from this research is waste of biomassa cakang + fiber of coconut and paddy chaff. Sampel which is taken away from by waste of biomassa coconut that is in the form is sampling, where based by for certain consideration because of its amount quantitatively is big enough.

Data Collecting

3.2.1 Data collecting for

a. Variable of free,

conducted by using ratio scale (comparison scale). In the following is tables comprising each;every element or member from population taken by as sampel there with ratio scale to be tested:

Tables 1: tables Sampel therewith rasioSampel Ratio

(%) Serabut	-	25
40 60 75 100		
Cangkang	50	
37,5 30 20 12,5	-	
Sekam	50	
37,5 30 20 12,5	-	

b. Variable control, conducted by

using indirect method (indirect method) or [is] also recognized with the hot loss method (heat loss). Reference standard to test the boiler by using indirect method is British Standard, BS 845:1987 and USA of Standard of ASME PTC-4-1 Power Test The Code Steam Generating Units [3]. Following [is] step [of] performed within using indirect method:

- **Phase I : Calculating theoretical air requirement**

$$\frac{(11, 43 \times C) + 34, 5 \times H_2 - O_2/8 + (4,32 \times S)}{100 \text{ kg /kg fuel}}$$
- **Phase II : : Calculating gratuity of air excess which (EA)**

$$\frac{\text{persen } O_2 \times 100}{21 - \text{persen } O_2}$$
- **Phase III : Calculating air mass in fact which / kg**
 Fuel (AAS)

$$1 + \frac{EA}{100} \times \text{udara teoritis} \times 100$$
- **Phase IV : Approximating entire/all hot loss**

1. percentage of heat Loss which is resulted from bya gas throw away dry

$$L1 = \frac{m \times C_{pfg} \times (T_{fg} - T_a) \times 100}{GCV_{fuel}}$$

2. hot Loss percentage because water evaporation formed by caused by its is H2 in Fuel

$$L2 = \frac{9 \times H_2(584 + C_{pss}(T_{fg} - T_a))}{GCV_{fuel}}$$

3. hot Loss percentage because rate evaporation irrigate in fuel

$$L3 = \frac{M 584 + C_{pss}(T_{fg} - T_a)}{GCV_{fuel}}$$

4. hot Loss percentage because rate evaporation irrigate in air.

$$L4 = \frac{AAS \times \text{kelembaban udara} \times C_{pss}(T_{fg} - T_a) \times 100}{GCV_{fuel}}$$

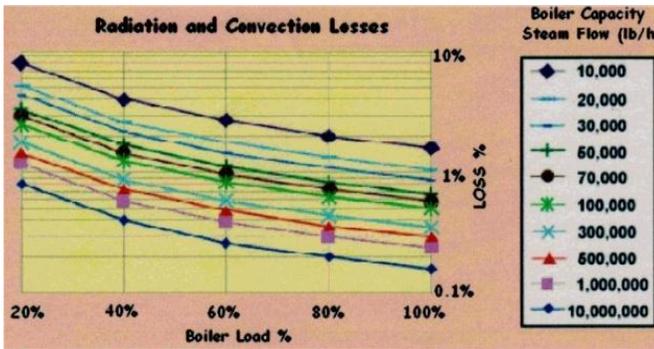
5. hot Loss percentage because fuel which [is] not burnt in ash flown / fly ash

$$L5 = \frac{\text{total abu terkumpul per kg bahan bakar yang terbakar} \times GCV_{fa}}{GCV_{fuel}}$$

6. hot Loss percentage because fuel which [is] not burnt in ash under / bottom ash

$$L6 = \frac{\text{total abu terkumpul per kg bahan bakar yang terbakar} \times GCV_{ba}}{GCV_{fuel}}$$

7. hot Loss percentage because radiasi and koveksi and also other;dissimilar loss [is] which [is] not counted Generally loss of effect [of] of lower radiasi convection and for the boiler of larger ones and higher for the boiler of smaller. Assess the loss of radiasi and convection [is] usually determined from graph of standard of American Boiler Manufacturers Association (ABMA) [4] what [is] presented [at] picture hereunder .



Draw the 2. Graph showing loss of radiasi and convection as according to accelerating mass flow [of] vapour yielded [by] boiler

3.3 Used Formula

As for formula used and support shall be as follows

1. Assess the kalor for (Countable HHV) with the formula $HHV = (T_2 - T_1 - T_{kp}) \times [Limited\ partner, cv] (kJ/kg)$ [1]
2. value Kalor [of] under (Countable LHV) with the formula $LHV = HHV - 3240\ kJ/kg$ [2]
3. If/When [done/conducted] [by] n multiply the examination

Hence: n

$$\frac{HHV}{rata-rata} = \sum_{i=1}^n \frac{HHV}{n} (kJ/kg) \quad [3]$$

$$\frac{LHV}{rata-rata} = \frac{HHV}{rata-rata} - 3240\ kJ/kg \quad [4]$$

Where :

- T1 = Water Temperature chilled [by] before flamed [by] 27,420C
- T2 = Temperature irrigate the cooler after enkindling 27,690C
- Tkp = increase of temperature of effect [of] of strand of metal [of] menyala 0,05 0C
- [Limited partner,cv] = Hot [of] type bomb the calorimeter 73529,6 kJ/ kg0C

4. Fuel requirement:

$$W_f = \frac{W_s (h_{sup} - h_a)}{nk(LHV)} \quad [5]$$

5. Analyse the space volume burn

$$V_{rb} = \frac{W_f (LHV)}{H_{iv}} \quad [6]$$

6. Sum up the air of fuel combustion

$$U_{og} = \frac{100}{23,1} \times (2,67 C + 8 H - O + S) \text{ kg udara/kg bb} \quad [7]$$

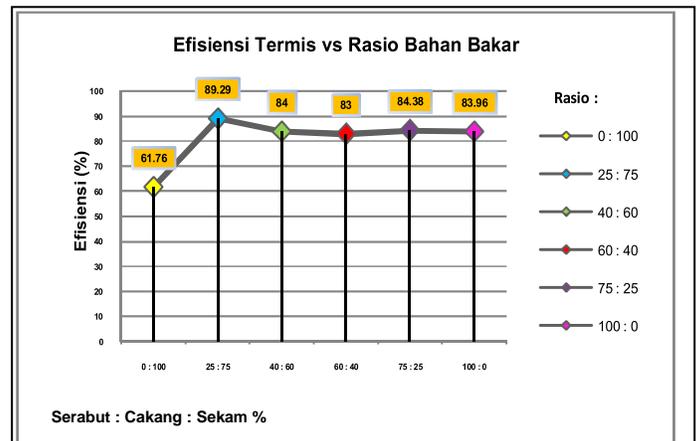
7. efficiency Boiler (η_b)

$$\eta_b = \frac{Q h_g - h_f}{q \cdot LHV} \times 100\% \quad [8]$$

4. ANALYSIS of DATA of EFFICIENCY THERMIS AND ASSESS THE KALOR FUEL

4.1 EFFICIENCY THERMIS

From calculation result done use the indirect method (indirect method) or [is] also recognized with the hot loss method (heat loss) with the reference standard to test the boiler [is] British Standard, BS 845:1987 and USA of Standard of ASME PTC-4-1 Power Test The Code Steam Generating Units, visible hence difference assess the efficiency termis capable to be reached from each;every variation of composition of examinee fuel at graph here under :



Draw the 3. Graph of variation of composition of fuel of fiber and cangkang coconut, lock up to efficiency of termis boiler

See that there are difference which enough sharply between ratio 100% cangkang and ratio 100% fiber to efficiency of termis boiler, that is : 61,76% and 83,96%. this Matter possibility is caused:

- a. Combustion of tardy cangkang kelapa,sekam relative because of cangkang, chaff contain the high carbon element that is about 45,74% compared to a fiber that is about 44,97.
- b. Combustion of cangkang coconut, lock up the inclusive of imperfect combustion. This matter cause the hot transfer decrease and hot lose because high ekses air (O?? high
- c. Variable trussed, in this case is efficiency of termis boiler, countable by tapering down part of hot loss from 100, thereby can be written down by into

Equation:

$$\eta_{th} (\%) = 100 - \sum Li$$

At visible above graph is existence of the make-up of efficiency of termis boiler of if done by addition of ratio cangkang to fiber of although difference of a few/little, and its top

Is got from mixture 25% fiber : 75% cangkang and chaff

4.2 Fuel

Fuel is substance which can be burned to yield the heat (kalar). Process the combustion represent the chemical process [among/between] fuel, air and heat. Process the combustion that happened in space burn the boiler (boiler) aim to for the fox of fasa irrigate to become the fasa condense. Various fuel type (like liquid fuel, solid, and gas) available by depend on various factor of like expense, availability, depository, handling, pollution and situating boiler, stove and other combustion equipments. Knowledge hit the nature of fuel assist in chosening real correct fuel for real correct and for the use of efficient fuel. Test the laboratory is usually used to study the nature of and fuel quality. Become to do the combustion needed by three element, that is

- Fuel
- Oxygen
- Temperature to start combustion

Hot kalar of arising out of because the fuel combustion referred by result of combustion or assess to burn the (heating value)

4.3 Value of Kalar Fuel

Assess the kalar (heating value) is to the number of energi heat obtained from combustion result 1 fuel singk. Assess this kalar is divided to become two:

- high value Kalar or High Heatingvalue (HHV) is to the number of kalar yielded at combustion process 1 singk of substance bakar,tanpa of[is existence of content irrigate at fuel
- Assess the low kalar or Low Heating Value (LHV) [is] to the number of kalar yielded at combustion process 1 fuel singk and some of exploited for the evaporation of so that

Tables of 1. attempt result assess the kalar Bomb the bagasse calorimeter (bagasse) content irrigate at fuel will used up

NO.	T1 0C	T2 0C	HHV (kJ/kg)	LHV (kJ/kg)
1	25,88	26,14	15441,216	12201,216
2	26,26	26,52	15441,216	12201,216
3	26,65	26,92	16176,512	12936,512
4	27,02	27,29	16176,512	12936,512
5	27,42	27,69	16176,512	12936,512

Tables of 2. attempt result assess the kalar Bomb the calorimeter fiber (fiber 75% + cangkang 25%)

NO.	T10C	T2 0C	HHV (kJ/kg)	LHV (kJ/kg)
1	25,93	26,27	21323,584	18083,584
2	26,44	26,78	21323,584	18083,584

3	26,94	27,77	20588,288	17348,288
4	27,38	27,73	22058,88	18818,88
5	27,96	28,30	21323,584	18083,584

Tables of 3. attempt result assess the kalar Bomb the calorie of metre of Oil of Residu MFO

NO.	T10C	T2 0C	HHV (kJ/kg)	LHV (kJ/kg)
1	25,55	26,37	56617,792	53377,792
2	26,43	27,27	58088,384	54848,384
3	27,35	28,17	56617,792	53377,792
4	28,29	29,12	57353,088	54113,088
5	25,13	25,95	56617,792	53377,792

Tables of 4. attempt result assess the kalar Bomb the metre calorie lock up paddy

NO.	T10C	T2 0C	HHV (kJ/kg)	LHV (kJ/kg)
1	25,55	26,37	5609,792	53377,792
2	26,43	27,27	5607,384	54848,384
3	27,35	28,17	5609,792	53377,792
4	28,29	29,12	56453,88	54113,088
5	25,13	25,95	5609,792	53377,792

Tables of 5. comparison of variation of fuel from facet consume the fuel, efficiency of boiler and material cost burn

Bahan Bakar	Efisiensi Boiler (%)
Minyak Residu MFO	73
Faiber (cangkang Kelapa +serabut)	65
Ampas Tebu (bagase)	62
Sekam Padi	71

- Assess the kalar bagasse of smaller than value of kalar of mixture of fiber and cangkang sawit. Assess the kalar of mixture of fiber and cangkang sawit much more is small compared to by value of kalar of fuel of oil residu. But use of bagasse fuel, fiber and cangkang coconut, paddy chaff upon which burn at PG MODJO PANGGUNG still be economic enough, considering its supply is which is quite a lot and free of charge, while oil residu much more costly.
- From this research result is obtained by result of value kalar influencing amount of big substance bakar.Semakin requirement assess the LHV progressively a few fuel used and influence the value of efficiency boiler

5. CONCLUSION AND SUGGESTION

5.1 Conclusion

1. Efficiency of Thermos boiler :

- Accelerate the make-up of efficiency of termis boiler happened by conducted by a ratio addition of at cangkang sawit, and experience of the degradation of conducted by a ratio addition of at fiber sawit although difference do not too big

- b. Composition Fuel which owning highest efficiency of termis obtain get from comparison fuel 25% fiber: 75% cangkang+ pacifying, whilst is fuel owning efficiency of termis terendah obtain get from comparison fuel 0% fiber: 100% cangkang + sekam
- c. Mount the difference of efficiency of termis of steaming kettle learn to use the indirect method when compare to resulted fromly by is data sekunder get the use is direct method about at usage fuel 75% because fiber 25% because cangkang chaff is exceeding from 5%, that is 11,38

From result of calculation and solution analyse the fuel usage by conducting examination assess the kalor and gas throw away to performansi boiler type water tube with the capacities condense 60 Ton / clock hence can be pulled by a the following conclusion

1. Assess the Kalor HHV and used LHV fuel
 - a. VALUE of HHVRATA-RATA AND LHVRATA-RATA bagasse

HHV= 15882,3936 kJ / kg

LHV= 12642,3936 kJ / kg

- b. ASSESS THE HHVRATA-RATA AND LHVRATA-RATA fiber (cangkang+ fiber)

HHV= 21323,584 kJ / kg

LHV= 18083,584 kJ / kg

- c. Assess the HHV and LHV of Oil of Residu MFO

HHV= 57058,9696 kJ / kg

LHV= 53818,9696 kJ / kg

2. used Fuel requirement a. requirement of bagasse Fuel

Wf = 19284,47 kgb.bakar / clock b. requirement of Fuel fiber (cangkang + fiber)

Wf = 13481,94 kgb.bakar / clock c. requirement of Fuel of oil of residu MFO

Wf = 4530,034 kgb.bakar / clock

3. Space Volume Burn the Vrb = 10902,48m³

4. Sum Up The Air of Fuel Combustion

- a. Sum up the air of combustion of bagasse fuel.

Uog = 21,604 air singk / kgbb

- b. Sum up the air of combustion of fuel fiber (cangkang + fiber)

Uog = 23,316 air singk / kgbb

- c. Sum up the air of combustion of oil of residu MFO

Uog = 59,25 air singk / kgbb

5.2 Suggestion

As for suggestion which can be raised by for factory and also reader to complete the research of about analysis of variation of fuel to performansi boiler later on day is as follows

1. In because old or old age boiler hence must be done optimal treatment so thatperformance boiler remain to be optimal
2. To increase efficiency of at boiler better be used by fuel of fiber or oil of residu MFO upon which burn the assistant

3. research of Planning of alternative fuel to performansi boiler hereinafter by using other fuel, for example bongol maize, and garbage of paper and also plastic
4. Fuel composition owning highest efficiency termis obtained from fuel ratio 25% fiber : 75% cangkang + lock up while fuel owning efficiency of termis terendah obtained from fuel ratio 0% fiber : 100 cangkang + lock up
5. Level of difference of efficiency of termis boiler studied to use the indirect method when compared to by result from data sekunder got use the direct method of at fuel usage 75% for the fiber of fiber and 25% for the cangkang of shell+ chaff is exceed from 5%, that is 11,38

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