



Productivity Analysis And Engineering Of Oil Palm Factory Productivity Process On Boiler Work Effectiveness At PTPN III PKS Sei Mangkei

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ARTICLE INFO

Article history:

Received Apr 08, 2021

Revised Mei 15, 2021

Accepted Jun 30, 2021

Keywords:

Effectivity
OEE
Six Big Losses
Palm Oil Mill
Boiler

ABSTRACT

The boiler works to produce steam by heating the boiler water pipes. Boiler has a very important role in the continuity of performance of a Palm Oil Mill in other words can be said as the heart of the Palm Oil Mill. Boilers that have been used for a period of 20 years will certainly experience a decrease in performance, using the Overall Effectiveness Equipment (OEE) method we can know the value of Boiler Effectiveness, to get the OEE value we can see from the maintenance track record that has been carried out by the company, OEE Boiler Value in 2017 obtained average value is 39.08%, this is caused by the high the value of Reduced Speed Losses on the Analysis of Six Big Losses in Boiler Sei Mangkei Palm Oil Mill, which is 79.01%.

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1. INTRODUCTION

Boilers have a very important role in the continuity of the performance of a palm oil mill, in other words, it can be said as the heart of a palm oil mill. The function of the boiler is to produce steam which is used for the needs of the factory process, and to generate electricity for the needs of the factory and employee housing around the factory.

Factory equipment in the form of a boiler system is a very important asset for the company. The boiler here has an important role in the steam production process, where this steam will later be used to drive a steam turbine as a producer of electrical energy for factory needs and the turbine output steam is used for the boiling process (sterilizer) and oil purification process (clarification).

In the boiler system, there is often damage to the pipe that is useful for draining the steam produced by the fuel combustion process in the form of shells and fibers. However, when the fuel is not balanced, the heat generated by the fuel is too excessive (overheating) causing the pipe to crack and rupture.

At PKS Sei Mangkei PTPN III, the maintenance method carried out is to make repairs after damage or breakdown maintenance occurs which causes the machine/factory facility to stop operating. This can prove that the machine maintenance planning at the company is not good.

At this time the Sei Mangkei PKS is experiencing a decline in productivity caused by sudden damage to the facility. The machines contained in this PKS are like a Boiler machine which functions to generate steam that drives the Turbine so as to produce electricity for the palm oil production process, if there is damage to the Boiler machine, all production process activities at the PKS can be disrupted / stop operating so we need to carry out proper maintenance. planned.

The maintenance method that should be carried out is preventive maintenance of the boiler. Boiler maintenance is intended to maintain the state of the equipment before the equipment becomes damaged. Basically, boiler maintenance carried out is to prevent unexpected damage and determine conditions that can cause production facilities to experience damage when used in the production process. Thus, all production facilities that receive preventive maintenance will be guaranteed smooth operation and are always maintained in a condition that is ready to be used for any production process at any time. This requires a very careful boiler maintenance plan and schedule and a more precise plan.

One of the approaches used to overcome the problems that occur in the boiler engine is OEE. OEE measures the total effectiveness (complete, inclusive, whole) of the performance of an equipment in carrying out a planned job, measured from actual data related to availability rate, performance efficiency, and quality of product (Williamson, 2006).

Nakajima (1988) states that the availability rate describes the utilization of the time available for machine operation activities. Performance rate describes how many products are produced during the production time. Quality rate is a ratio that describes the ability of equipment to produce products that comply with standards.

Information obtained from OEE will be used to identify and classify the causes of low performance of an equipment. The assessment related to the OEE of machines following global standards is 90% for the value of the availability rate, 95% for the performance rate, and 99% for the quality rate or 85% for the OEE value of an equipment (Hegde., et al, 2009).

After determining the OEE value, six big losses are calculated. The term six big losses are the six main losses that must be avoided by a company that can affect the effectiveness of a machine. Of the six main losses, they are grouped into three, namely downtime losses, speed losses, and quality losses. The three types of factors are generally translated into several types of losses, namely downtime losses (breakdown losses, set up and adjustment), speed losses (idle and minor stoppage, reduce speed), quality losses (process defect, and reduce yield) (Jeong & Philips, 2001).

2. RESEARCH METHOD

- a. Orientation Preparation. Prepare things that are necessary for research activities, make requests for final works and consultations with supervisors.
- b. Literature Study. Literature study is studying books - books of scientific writing related to the topic of the problem in this research.
- c. Field survey. The author conducted a survey to PTPN III Sei Mangkei to see the condition of the Boiler engine.
- d. Data collection. The data collection carried out in the preparation of this final project is by: Direct observation of the object.
 - a. Looking for books about Boiler engines.
 - b. Looking for data - data about Boiler engine through internet media.
- e. Data Analysis and Evaluation. The data that has been obtained is analyzed and evaluated together with the supervisor.
- f. Make a report. Namely making a final project report in connection with the data - the data that has been obtained.
- g. Assistance Reporting results Duty end which has typed to lecturer mentor.

3. RESULTS AND DISCUSSIONS

3.1 Production Data

Production data at PT. Perkebunan Nusantara III PKS Sei Mangke is presented in Table 1 below. This data is a recapitulation of the production report at PT. Perkebunan Nusantara III PKS Sei Mangkei.

Table 1. FFB data processed in January – December 2017

Month	FFB processed (Tons)
January 2017	18,639.0
February 2017	12,267.0
March 2017	11,776.5
April 2017	14,174.5
May 2017	14,868.0
June 2017	13,720.0
July 2017	17,034.5
August 2017	14,869.5
September 2017	24,124.0
October 2017	17,536.5
November 2017	20,144.0
December 2017	19,103.0

In Table 1 we can see that the FFB processed in January – December 2017 varied from 11,776.5 tons – 24,124.0 tons, this shows that the palm oil production received by the mill changes every month, this is related to the oil palm fruit harvested by the company. plantations and oil palm fruit owned by the people around the mill, and in 2017, the most FFB processed was in September 2017.

a. Data Breakdown TimeBoiler line I

From the results of the data obtained from the Boiler line I engine, one of the factors that caused damage to the Boiler line I was the rupture of the Pipe in the Boiler so that the Boiler Machine stopped (Machine Break) for a while. Time data of damage to the Boiler line I engine can be seen in table 2 below. Total Breakdown = Machine Break + Non Productive Time = 18.0 + 2.0 = 20.0 Hours.

Non-productive time is time that is not productive due to the machine stopping repeatedly or operating without producing a product in hours.

Tabl 2. Data Breakdown Time for Boiler Line I Machines January – December 2017

Month	Machine Break	Non-Productive Time (Hour)	Total Breakdown (O'clock)
January 2017	18.0	2.0	20.0
February 2017	42.0	1.5	43.5
March 2017	18.0	1.5	19.5
April 2017	37.5	3.0	40.5
May 2017	27.0	1.0	28.0
June 2017	15.0	1.5	16.5
July 2017	40.0	2.5	42.5
August 2017	16.5	1.0	17.5
September 2017	13.0	1.0	14.0
October 2017	20.0	3.5	23.5
November 2017	36.0	1.5	37.5
December 2017	21.0	2.0	23.0

In Table 2 we can see that in January 2017 – December 2017, the total Breakdown time at Sei Mangkei PKS varied from 14 hours – 43.5 hours per month this was caused by damage such as the Water Tube (Pipe) cracked, The IDF engine was damaged such as the Fan Belt Broken / Loose and other damage so that the Boiler Engine had to stop operating for checking and repairs on the Boiler Line 1 engine.

b. Data Planned Downtime and Set Up Time for Boiler Machines

From the results of the data obtained from the Boiler Machine line I, data on maintenance time and Set Up on the Boiler line I machine can be seen in table 3 and table 4 below.

Table 3. Data on Maintenance Time (Planned Downtime) Boiler Line I Machine January – December 2017

Month	Total Available Time (Hours)	Total Planned Downtime	
		O'clock	%
January 2017	389.5	2.5	0.64
February 2017	403.5	3.0	0.74
March 2017	425.0	1.5	0.35
April 2017	532.5	2.0	0.37
May 2017	539.0	2.5	0.46
June 2017	479.5	1.0	0.20
July 2017	615.5	2.0	0.32
August 2017	498.5	1.5	0.30
September 2017	431.5	2.0	0.46
October 2017	461.0	2.5	0.54
November 2017	492.5	1.5	0.30
December 2017	491.5	2.0	0.40

In the table above, we can see that the Total Planned Downtime in January – December 2017 varies from 1 hour – 3 hours per month, things that employees do in Planned downtime carry out routine maintenance on the Boiler Machine, such as cleaning the dust that sticks to the pipes – pipes in the combustion chamber and the walls of the combustion chamber.

Table 4. Data on Set Up Time for Boiler Machine line I January-December 2017

Month	Total Available Time (O'clock)	Total Set Up (O'clock)
January 2017	389.5	1.5
February 2017	403.5	3.0
March 2017	425.0	2.0
April 2017	532.5	1.5
May 2017	539.0	2.0
June 2017	479.5	1.0
July 2017	615.5	3.5
August 2017	498.5	1.5
September 2017	431.5	2.0
October 2017	461.0	1.5
November 2017	492.5	3.5
December 2017	491.5	1.0
	Total	19.5

In the table above we can see that the total set up time varies in January – December 2017 which is 1.0 hours – 3.5 hours, so if we calculate the total set up time in a year we can see the average time of the Sei Mangkei PKS do Set Up per month that is $19.5 / 12 = 1.625$ Hours / month.

c. Boiler line engine delay data I

From the results of the data obtained from the Boiler Line I Machine, the delay data on the Boiler Line I Machine can be seen in table 5 below.

Table 5. Boiler Line I Engine Delay Data January-December 2017.

Month	Total Available Time (Hour)	Total Breakdown (O'clock)	Total Planned Downtime (O'clock)	Total Set Up (Hours)	Total Delay (O'clock)
Jan-2017	389.5	20.0	2.5	1.5	24.0
Feb-2017	403.5	43.5	3.0	3.0	49.5
March 2017	425.0	19.5	1.5	2.0	23.0
Apr-2017	532.5	40.5	2.0	1.5	44.0
May-2017	539.0	28.0	2.5	2.0	32.5
Jun-2017	479.5	16.5	1.0	1.0	18.5
Jul-2017	615.5	42.5	2.0	3.5	48.0
Aug-2017	498.5	17.5	1.5	1.5	20.5
Sep-2017	431.5	14.0	2.0	2.0	18.0
Oct-2017	461.0	23.5	2.5	1.5	27.5

Nov-2017	492.5	37.5	1.5	3.5	42.5
Dec-2017	491.5	23.0	2.0	1.0	26.0

In the table above, we see the total delay time in January 2017-December 2017 varies from 18.0 hours - 49.5 hours, the total delay time is obtained from the sum of Breakdown time, Planned Downtime and Boiler Machine Set Up Time.

3.2 Analysis Calculation Overall Equipment Effectiveness (Oee)

The analysis was carried out for the calculation of Overall Equipment Effectiveness at PT. Perkebunan Nusantara III PKS Sei Mangkei was conducted to see the level of effectiveness of using the Boiler line I machine during January-December 2017. The Overall Equipment Effectiveness (OEE) measurement is the multiplication of Availability Ratio, Performance Efficiency and Rate of Quality Products.

- a. During the January-December 2017 period, the Overall Equipment Effectiveness (OEE) value was obtained which ranged from 29.42 %-64.03% and the results of the Performance efficiency ratio which ranged from 37.72%-75.84% and availability had remained between 88.38%-96.34%.
- b. The highest OEE value was in June 2017 of 64.03% due to the high level of performance efficiency ratio used reaching 75.84%.

3.3 Oee Six Big Losses Calculation Analysis

Reduces Speed Losses factor which has the largest percentage of the six factors that cause losses that affect the effectiveness of the boiler line I machine.

a. Manipulation Calculation Overall Equipment Effectiveness (Oee)

Engineering analysis is carried out to increase the value of Overall Equipment Effectiveness (OEE) at PT. Perkebunan Nusantara III PKS Sei Mangkeid and increased the effectiveness of the Boiler line I engine during January-December 2017. This Overall Equipment Effectiveness (OEE) measurement is the product of the Availability Ratio, Performance Efficiency, and Rate of Quality Products.

b. Engineering Performance Efficiency Perhitungan

Performance efficiency is the ratio of product quality multiplied by the ideal cycle time to the time available, to carry out the production process (operation time).

After we engineer the calculation of Equipment Failures, we can see that the difference between the real average value of Equipment Failures and the engineering value is 5.675 % - 2.22%, which is 3.455 %. The engineering value of Equipment Failures can increase the effectiveness of the production process, by optimizing the average Loading Time, which is 450 hours / month and maintaining the Total Breakdown Time, which is 10 hours / month.

Good maintenance on boilers is Preventive Management which can guarantee a relatively long technical life and economic life. The following is the maintenance management carried out on the Boiler to maintain the effectiveness of the Boiler engine.

Every 1 to 2 weeks:

- 1) Check and clean the strainer (filter), water and steam.
- 2) Inspect and clean the pipes and flint walls of all ash and burning scale adhering to the walls.
- 3) Check the blower rotor (impeller) especially the blower ID Fan impeller for the possibility of adhering ash.

Every 1 to 3 months.

- 1) Inspect and clean the outside and inside of the boiler.
- 2) Clean the inside of all water tubes (pipes) and all headers and drums from scale (crust).
- 3) Check the roster and replace it if it is broken/damaged.
- 4) Clean all the ashes from inside the chimney.

Above 1 year :

- 1) Check and maintain the casing (wall).
- 2) Check and maintain gas duct and dust collector.
- 3) Inspect and maintain collectors, equipment and instruments.
- 4) Check and maintain shells, cocks and piping.

Every 2 years:

- 1) Every 2 years, periodic inspections are carried out which are witnessed by the local Ministry of Manpower.

4. CONCLUSION

During the January-December 2017 period, the average Overall Equipment Effectiveness (OEE) at Sei Mangkei PKS was 39.08 % where the OEE value was far from the predetermined standard value of 85 % (according to JIPM world class benchmark standards).

From the analysis of the six big losses, it is known that the causes of the low OEE value are reduced speed losses by 79.01%, breakdown by 9.17%, idling minor stoppages 0.62%, setup and adjustment 0.67%, scrap/yield losses 10.51% and rework losses 0%.

After we did the engineering to increase the Effectiveness value, the engineering value of OEE for 2017 was 56.61%, where the real OEE value in 2017 was 39.08%, the OEE value increased by 17.53%.

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