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Reliability Analysis for Rotary Feeder 561 BF 1 at PT Semen Bosowa Banyuwangi

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Abstract. Maintenance is an important activity in a manufacturing company. This paper focuses on reliability analysis for Rotary Feeder 561 BF 1 at PT Semen BosowaBanyuwangi. Mean Time to Failure and Reliablity were calculated. We concluded thatreliability at running time 240 hours or 10 days is 99.33%, while reliability damage at running hours 1920 hours or 80 days is 60.48% therefore before running hours 1920 equipment and materials need to be prepared for corrective maintenance.

Keywords: Maintenance Management, Reliability, Equipment, Running Hours, Corrective Maintenance

INTRODUCTION

The application of management is not only for organizations, but also production management, inventory management, quality management, and maintenance management, they are contribute to develop the technology. So that businesses actor are required to innovate to show their existence and superior quality. Business actors need superior supporting components to innovate, such as labor, capital, land, and licensing. One business actor who has implemented management is PT Semen BosowaBanyuwangi. This company is one of the producers in cement production. Production activities are carried out at any time as long as raw material is available and silo capacity can still accommodate cement. In cement production, there is a main machine that have a function to mix the raw material of cement to become cement dust, it is grinding mill. Based on the results of interviews with the mechanical section, the component most often experiencing damage is the component in the grinding mill, especially in the 561 BF1 rotary feeder.

(Ngadiyono, 2010) Determining the damage time of a machine requires a more careful calculation (based on empirical data) that the admin inputs. So the company can determine the rating of reliability of the machine and can find out when the machine needs to be repaired in accordance with the rating of machine reliability. The calculation of engine reliability is only in the rotary feeder 561 components and only in the mechanical section work area.

In general, the mean of maintenance will not be separated from the work of repairing, dismantling, or inspecting the engine thoroughly. So in general the definition of maintenance as follows:

a. Keep
   Routine work that aims to keep the facility always in such conditions that it can be used continuously.
b. Preserve
   Activities such as tests, measurements, replacements, adjustments, and repairs to maintain or restore the function of components/units so that they can perform the functions needed for the company.
c. Protect
   All actions aimed at protecting the company's assets from various constants so that they can work optimally, such as inspection, testing, service and all actions willundertaken to maintain the power to carry out its functions.

In the science of machine maintenance, a component/unit and other facilities are not able to produce forever, so that the component/unit has a certain age. The bathtub curve shows the relationship of failure rate to the time of using a production machine.

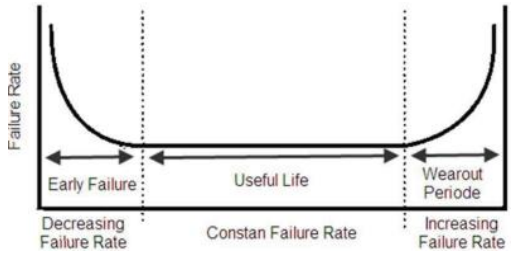

Figure 1. Bathtub Curves.

In the bathtub curve shows that at the beginning of the use of the machine, the damage will be more frequent. However, in the middle of the engine use will be more stable and durable. And at the end of the use of the machine will be more often damaged.

Maintenance has a general goal which is to extend the life of the machine, therefore it can carry out the production process and produce output that is company's expected, for examplein shape, size, and standardization of related companies. However, the maintenance goals are detailed as follows:

a. Ensuring the optimum availability of appropriate equipment to meet planned production activities and production processes can obtain maximum investment profit.
b. Extend the productive life of a machine in the workplace, buildings and all inside it.
c. Guarantee the availability of all equipment needed in an emergency.
   Ensuring the safety of all people/operator at using these facilities.

(Kurniawan, 2013), reliability indicates the existence or condition of a facility. These conditions can be said to be positive or negative. The concept of reliability involves statistical methods. Through this measurement, the company has a description of the condition of the equipment,it can predict the treatment of the equipment. Reliability can also be quantified by using the average number of failures in a certain period (failure rate), and can be expressed as an average length of time between failures (MTBF).

Kurniawan (2013), also wrote in his book that reliability engineering was born out of the complexity of the use of equipments and components, as well as the damage that occurred from the impact of the use of tools that resulted in an increase in the cost of parts, equipment, and logistics. This concept has been started since 1950 in the United States. In general, reliability will affect the availability or tools availability to function properly, especially for products / repairable items.

In the calculation of reliability requires several steps as follows:

a. Determine data distribution
b. Perform linear regression calculations in accordance with the distribution test
c. Search for local meter shapes and parameters (alpha, teta, and beta)
d. Calculating reliability

MATERIALS AND METHODS

Procedures

Research Methodology

There are three data collection techniques needed, namely:a. Interview data. The interview data was collected by asking the employees of PT Semen Bosowa Banyuwangi, those are the head plant, head department, head section, and staff at PT Semen Bosowa Banyuwangi. Interviews were conducted directly to obtain information from the company.; b. Observation data, collecting data in the fieldto get actual information that are more detailed.; c. Literature review,; look for references in books or research journals to support the analysis conducted, and help in solving problems in theory.

Flowchart

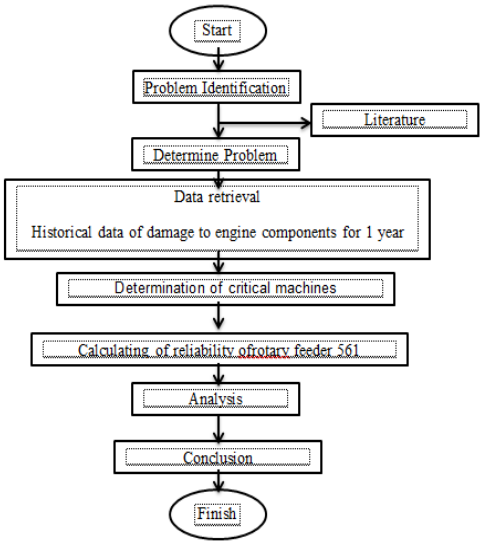

Figure 2 Flowchart.

Data analysis

Frequency of Engine Damage

Based on historical data of PT Semen BosowaBanyuwangi, corrective maintenance data for 9 September 2018 - 9 September 2019 engine damage frequency as follows:

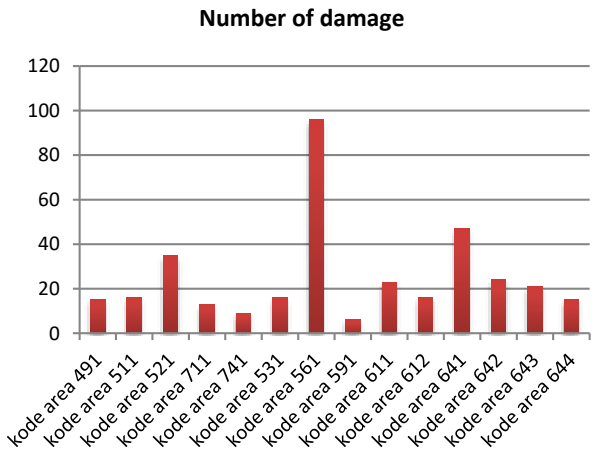

Figure 3. Graphic of Damage.

Based on the amount of damage, the equipment area 561 is the machine that has the highest frequency of damage, therefore decision making to calculating of reliability of 561 grinding mill.

Calculation of the depth of the rotary feeder mill is as follows:

Table 1. Table of damage rotary feeder.

561 RF 1	Finish	End	Start	Start	TTF
Casing rotary feeder aus	14:00	03.11.2018	02.11.2018	19:30	3794
casing rotary feeder bocor/aus	11:15	14.03.2019	14.03.2019	8:15	3138,24
chute rotary feeder aus	10:00	08.05.2019	07.05.2019	8:15	1293
Chute rotary feeder sering aus	16:30	18.07.2019	18.07.2019	8:00	1702
Casing Rotary feeder aus (timur&barat)	16:30	24.09.2019	23.09.2019	13:15	1604,75
Total					

RESULTS AND DISCUSSION

The calculation steps for machine reliability are as follows:

Determination of Data Distribution

Damage data distribution test results (TTF) of the 561.RF1 rotary feeder machine using Minitab software are as follows:

Goodness-of-Fit

Anderson-Darling Distribution	(adj)
Weibull	**2,624**
Lognormal	2,641
Exponential	2,997
Normal	2,685

The TTF data distribution test results show that the operating data is distributed with **Weibul**.

MTTF calculations

Perhitungan regresi linear (yi dan xi)

x_i = ln(ti) y_i = ln(ln(1/1-f_{ti})

x_i = ln(1293) y_1 = ln(ln(1/1-0,13)

= 7,16 = -1,97

$f_{ti} = \frac{i-0,3}{n+0,4}$

$f_{t1} = \frac{1-0,3}{5-0,4} = 0,13$

Perhitungan a dan b

$b = \frac{n\sum xiyi - \sum xi \sum yi}{n\sum xi^2 - (\sum xi)^2}$

$= \frac{(5\ .\ -17) - (38,28\ .\ -2,4\ )}{(5\ .\ 293,90) - 1465,17}$

= 2,076

$a = \frac{\sum yi}{n} - b\frac{\sum xi}{n}$

$= \frac{-2,45}{5} - 2,076\frac{38,28}{5}$

= -16,385

Perhitungan parameter bentuk (α) dan parameter skala (θ)

α = a= -16,385

β = b= 2,076

$\theta = e^{\frac{-\alpha}{\beta}} = 2,718^{\frac{-(-16,385)}{2,076}} = 2673,49$

$MTTF = \theta\ \Gamma\ 1 + \frac{1}{\beta}$

$= 2673,49\ \Gamma\ 1 + \frac{1}{2,4036}$

$= 2673,49\ (\Gamma\ 1,4159)$

$= 2673,49* 0,88575 = 2368,004$

So the average operational time based on Weibull distribution is 2368,004 hours or 98,668 days.

Reliability Calculation

Unit 1 day = 24 hours; 10 days = 240 hours

Known :

β = 2,076

e = 2,718

θ =2673,49

t = 240 hours

Asked: Reliability of the 561 RF1 rotary feeder?

Answered:

$R(t) = e^{-\left(\frac{t}{\theta}\right)^{\beta}}$

$R(240) = 2,718^{-\left(\frac{240}{2673,49}\right)^{2,076}}$

$R(240) = 0,9933$

So the rating of the reliability of the machine in the period of 240 hours or 10 days is equal to 99.33%. The results of the calculation of reliability and can be presented in tabular form as follows:

Table 2. Reliabilites Rating per 240 hours.

t	R_t (%)
240	99,33
480	97,21
720	93,65
960	88,76
1200	82,73
1440	75,83
1680	68,31
1920	60,48
2160	52,62

While the results of the calculation of reliability can be presented in graphical form as follows:

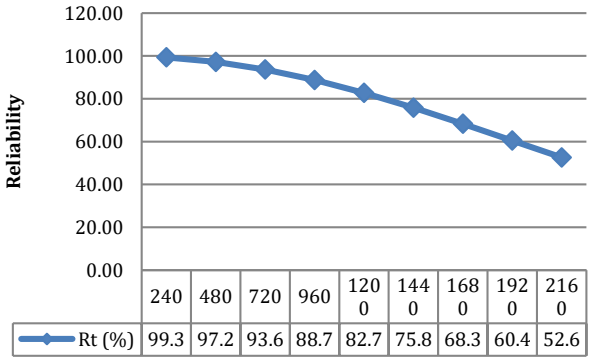

Figure 4 Graphic of Relaibility.

Discussion

Reliability at running time 240 hours or 10 days is 99.33%, while reliability damage at running hours 1920 hours or 80 days is 60.48% therefore before running hours 1920 equipment and materials need to be prepared to conduct corrective maintenance

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