Journal of Economics
AND MANAGEMENT SCIENTIES
https://jems.ink
ISSN 2655-1934 (print), 2655-6685 (online)

Reliability Centered Maintenance Method on Quotient Gradient System (QGS) in Production at PT ABC Dumai

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ARTICLE HISTORY

Received: 16 April 24
Final Revision: 26 April 24
Accepted: 01 May 24
Online Publication: 30 June 24

KEYWORDS

Production, Maintenance, Efficiency, Reliability Centred Maintenance (RCM), Quotient Gradient System (QGS)

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DOI

10.37034/jems.v6i3.59

A B S T R A C T

Quotient Gradient System (QGS) is a powerful crusher and dryer designed based on reference drying equipment with good performance efficiency. QGS has a very important function in expediting the production process, but this tool often breaks down so it really affects the smooth production. In connection with the damage to the tool needs to be examined to find out what maintenance should be done. This study aims to find out earlier the damage that affects the smooth production so that it can be known what maintenance actions must be carried out. This study uses the Reliability Centered Maintenance method which utilizes information on reliability and weaknesses as well as maintenance actions to choose from. The results of this study found a solution that the QGS treatment run to failure was 81.2%, direct condition was 18.18%, and failure finding was 0%. The conclusion of this study is Condition Directed, namely the actions taken aim to detect damage by visual inspection, checking tools and monitoring a number of existing data.

1. Introduction

The development of technology in Indonesia is very fast and increasingly sophisticated, so that it can be felt by the community in various activities and daily life. Technological changes that occur can already be used and utilized so that it can cause changes in the resulting input and output components. Increasing the need for productivity by utilizing the use of high technology in the form of machines and production facilities, the need for maintenance functions is getting bigger [1].

The use of technology requires planned and good maintenance which will be very important so that the production process runs smoothly so that it is not constrained in production [2]. This is what PT ABC Dumai is currently doing.

PT ABC Dumai is a company engaged in the production and management of Bleaching where there are several production machines that have several sequential operation processes. One of the operating machines is the QGS which requires maximum maintenance [3]. The QGS machine has a very important function in streamlining the production process, so it requires readiness for routine maintenance in order to create smooth production. So far, the QGS machine is still performing maintenance which is used with corrective measures, so a better solution method is needed to minimize damage and maintenance costs by using the Reliability Centered Maintenance (RCM) method [4].

Increasing operational results, lowering the effectiveness of operating costs and maintenance systems, as well as increasing the availability and reliability of equipment, and longer engine component life requires [5]. The application of the RCM method which will provide benefits, So the purpose of this research is to find out earlier the damage that affects the smooth production so that it can be known what maintenance actions must be taken. Once the importance of a good maintenance system in QGS, it is necessary to conduct research on the Application of the Reliability Centered Maintenance Method at QGS at PT ABC Dumai [6].

1.1 Maintenance

Preventive maintenance is a maintenance activity that is carried out before an asset is damaged and aims to prevent asset damage [7]. Corrective maintenance is a maintenance activity carried out after an asset has failed with the aim of returning the asset to its original condition so that it can carry out its functions properly [6].

1.2 Reliability

Reliability or reliability is the opportunity that an asset will perform a function needed within a certain period of time when in operating conditions [7]. The reliability value of an asset is expressed in the form of an opportunity with an R (Reliability) value between 0 and 1. A value of 1 indicates that the condition of an asset can run according to its function without failure. A value of 0 indicates the condition of the asset cannot function at all.

1.3 Reliability Centered Maintenance (RCM)

Reliability Centered Maintenance (RCM) is a process for determining what must be done so that each physical asset can continue to perform its function [7]. The main objective of RCM is to maintain system function by identifying failure modes and prioritizing failure modes and selecting effective and applicable preventive maintenance actions. According to Moubray [7], in using RCM there are 7 stages, namely:

a. System selection and information gathering
b. Definition of system boundaries
c. System description
d. Determination of function and functional failure
e. Failure Mode and Effect Analysis (FMEA)
f. Logic Tree Analysis (LTA)
g. Task Selection (Selection of maintenance policies)

1.4 Types of Treatment

There are 2 types of maintenance, namely Preventive Maintenance and Corrective Maintenance [8]. Preventive Maintenance Preventive maintenance is maintenance (prevention) activities carried out before damage occurs. The actions taken in preventive maintenance can be divided into 4 categories.

a. Time Directed Maintenance (TD) Preventive maintenance activities carried out periodically on a piece of equipment so that the tool returns to its original condition, before the tool is replaced by a new tool.
b. Condition Directed Maintenance (CD) Preventive maintenance activities carried out in accordance with ongoing conditions where the time variable is not known when exactly, so it is not known that damage will occur to the equipment.
c. Failure Finding Maintenance (FF) Preventive maintenance activities carried out by checking hidden functions periodically or scheduled, to determine when a component will fail.
d. Run to Failure Maintenance (RTF) Maintenance activities that aim to find out when damage occurs by letting a tool operate until the tool is damaged

Corrective Maintenance is an unplanned maintenance (repair) activity to restore work performance or equipment capability to its original condition. Actions taken in the form of component replacement, minor repairs and major repairs at the end of a certain period (overhaul) [9].

2. Research Method

Data collection methods used in this study are documentation, literature methods and literature studies. The method used for data retrieval is document in nature, such as a work request at PT ABC Dumai.

The data analysis technique used in this study uses the Reliability Centered Maintenance (RCM) method. The stages of data analysis are system definition and initial information collection regarding QGS, describing the system and functional block diagrams, determining system functions and malfunctions, Failure Mode and Effect Analysis (FMEA), Logic Tree Analysis (LTA) and Task Selection [6].

There is a method used by PT ABC which is in the following flow chart. The research flow chart can be seen in Figure 1.

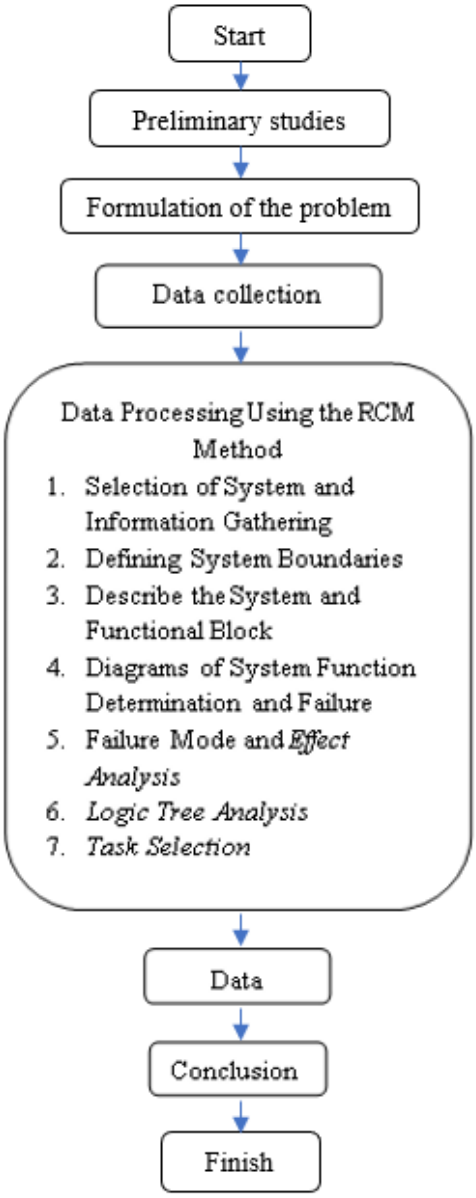

Figure 1. Research Flow Chart

3. Result and Discussion

After identifying the engine, the breakdown frequency was obtained by calculating the damage that occurred from June 2022 to January 2023.

Table 1. QGS Breakdown Frequency

No.	Item Breakdown	Frequensy Breakdown
1	Repair Hammer/Crusher	20
2	Repair Ducting	18
3	Repair Oil Pump	13
4	Repair Feeding	12
5	Repair ID Fan	11
6	Repair Dust Collector	9
7	Repair Thermocouple	6
8	Repair Bucket Cangkang	4
9	Repair Slag Tap	3
10	Penggantian Bolt	1
11	Repair Elbow	1
Total		98

Table 1 can be seen that the repair hammer / crusher damage has the highest breakdown frequency of 20 and the lowest is bolt replacement and elbow repair, namely 1.

Determination of system functions and malfunctions is an activity to describe each system and equipment component and identify all functions and interfaces with other systems or systems [10] and identify all functional failures can be seen in Table 2. If the functional of the system and components have been made, then proceed with making a sequence of functional failures [11].

Table 2. Determination of Component Function in QGS

No.	Machine Failure Description	System Failure Description	Component Failure Description
1	Hammer / Crusher Does Not Operate	Unable to Smooth the Production Material	Components Inside the Machine are Broken, Worn
2	Inoperable Ducting	Cannot Distribute Air and Product	The Presence of Leaks, Cracks and Corrosion
3	Oil Pump Does Not Operate	Oil is Not Completely Used	There is A Leak, Clogged, Burning Motorbike
4	Feeding Does Not Operate	Unable to Distribute Production Materials	The Belting is Torn, The Drum Roller is Worn
5	ID Fan Does Not Operate	Stop Sucking Air	The Clutch Bolt Broke, The Impeller Broke
6	Thermocouple Not Working	Indicator Temperature Error	Failure Protective Ceramics
7	Dust Collector Does Not Operate	Product Mixed with Dirty Particles	The Components Inside are Worn Out
8	Bucket Cangkang Does Not Operate	Furnace Fuel is Not Filled	Failure Bolt, Broken Cable Alternately
9	Slag Tap Does Not Operate	Pile of Dirt from Combustion Under the Furnace	Chains Break, Sporkets are Worn
10	The Bolt Cannot Be Used	Machine Components are Not Tight	Damaged, Rusty Threads
11	Elbow Cannot Be Used	Cannot Distribute Air and Product	Cracking, Corrosion

The preparation of a Logic Tree Analysis (LTA) is a qualitative process used to determine the consequences of each failure [12]. The purpose of LTA is to classify failure modes into several categories so that the priority level can be determined in the handling of each failure mode based on the category [13].

Table 3. Failure mode QGS Component A

No.	Component	Category A	Category B	Category C
1	Hammer/Crusher	-	√	-
2	Ducting		-	√
3	Oil pump	-	√	-
4	Feeding	-	√	-
5	ID fan	-	√	-
6	Thermocouple	-	-	√
7	Dust collector	-	√	-
8	Bucket	√	-	-
9	Slag tap	-	-	√
10	Bolt	-	-	√
11	Elbow	-	√	-
	Total	1	6	4

The compilation of logic tree analysis by determining the category of LTA components is obtained from the results of interviews with maintenance technicians [3] as in Table 4. The following is the calculation for determining the percentage of components from each category:

Table 4. QGS Component Category

No.	Category	Main component	Percentase (%)
1	A atau D/A	1	9,1
2	B atau D/B	6	54,54
3	C atau D/C	4	36,36
Total		11	100

Table 4. It can be seen [14] that there is 1 component (9.1%) which is included in category A or a safety problem where this failure can endanger operator safety. There are 6 components (54.54%) that are included in category B or outage problems, which if these components occur, production does not run smoothly until it stops operating. Furthermore, there are 4 components (36.36%) which are included in category C where if this component occurs, the repair loss is relatively small.

Next is the task selection which is the last step in implementing the Realibility Centered Maintenance (RCM) method [7]. This step is also a step to determine the maintenance strategy for an equipment that must be selected. The following is the maintenance system and the resulting actions with the Realibility Centered Maintenance (RCM) approach as an action plan for each component [14].

Then the selection of QGS mating action is done in 3 categories, namely condition directed, failure finding and run to failure [15] can be seen in Table 5.

Table 5. Selection of QGS Treatment Measures

No.	Category Task Selection	Component	Percentase (%)
1	Condition directed	2	18,18
2	Failure finding	0	0,00
3	Run to failure	9	81,20
Total		11	100,00

Table 5 can be seen that there are 9 components from 11 components (81.2% of all components) that are included in the category of treatment for run to failure. Run to failure is a treatment that does not make efforts to anticipate damage. An equipment or machine is allowed to work until it is damaged and then repaired is carried out. Based on the results of the repair data that has been obtained during this research, it was found that the components that often experience failure and damage are included in the run to failure category in the ducting. This category of maintenance actions aims to make it easier to determine the most appropriate maintenance action for each failure / damage mode of each machine component. In the end, this categorization of actions can help companies minimize downtime, increase the availability of each machine, increase machine life, improve production quality, and ensure machines can be used according to their functions.

4. Conclusion

The results showed that the categories based on component groupings contained 81.52% Run of Failure. This high level of damage indicates that the

maintenance or maintenance system on QGS is by taking actions including Run to Failure, namely this maintenance action does not make any effort to anticipate damage, and the machine is left to work until it is damaged then repair maintenance is carried out, provided that spare parts are prepared if any damage occurs. In the Condition Directed category there was 18.18%, so the actions taken were to detect damage by means of visual inspection, inspecting tools and monitoring a number of existing data. Failure Finding is 0%, due to the actions taken so far by finding hidden equipment damage, periodic inspections and the availability of special tools. The damage that occurred was in the Run of Failure category of 82.52% and Condition Directed of 18.18%, so the selected treatment was in the Condition Directed category

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