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Application of the Reliability-Centred Maintenance Method at QGS in PT ABC Dumai

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A B S T R A C T

QGS A1 is a powerful crusher and dryer designed based on reference drying equipment with good performance efficiency. It has a very important function in expediting the production process, but this tool often breaks down, which really affects smooth production. In connection with the damage to the tool, it 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 and a list of maintenance actions to choose from. The results of this study found a solution: the QGS A1 treatment run to failure was 81.2%, the direct condition was 18.18%, and the failure finding was 0%.

1. INTRODUCTION

1.1. *Research Background*

The development of technology in Indonesia is very fast and increasingly sophisticated so it can be felt by the community in various activities and daily life. Technological changes that occur can already be used and utilized to cause changes in the resulting input and output components. Increasing the need for productivity by utilizing high technology in the form of machines and production facilities, the need for maintenance functions is getting bigger [1]. The use of technology requires planning and good maintenance, which is very important so that the production process runs smoothly and 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 bleach, where several production machines have several sequential operation processes. One of the operating machines is the QGS A1, which requires maximum maintenance [3]. This A1 QGS machine has a very important function in streamlining the production process, so it requires readiness for routine maintenance to create smooth production. So far, the QGS A1 machine is still performing maintenance, which is used with corrective measures, so a better solution method is needed to minimize damage and maintenance costs, which is the Reliability-centered Maintenance method [4].

Increasing operational results, lowering the effectiveness of operating costs and maintenance systems, increasing the availability and reliability of equipment, and requiring longer engine component life are required [5]. The application of the RCM method will provide benefits. 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 A1 is established and acknowledged, it is necessary to research the application of the reliability-centered maintenance method at QGS A1 at PT ABC Dumai [6].

1.2. *Literature Review*

1.2.1. *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 [8].

1.2.2. Reliability

Reliability or reliability is the opportunity that an asset will perform a function needed within a certain period when in operating conditions [9]. An asset's reliability value is expressed as 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 that the asset's condition cannot function at all.

1.2.3. Reliability-Centered Maintenance (RCM)

Reliability-centered Maintenance (RCM) is a process that determines what must be done so that each physical asset can continue to perform its function [10]. The main objective of RCM is to maintain system function by identifying failure modes, prioritizing failure modes, and selecting effective and applicable preventive maintenance actions. According to Moubray [10], in using RCM, there are 7 stages, namely:
1. System selection and information gathering
2. Definition of system boundaries
3. System description
4. Determination of function and functional failure
5. Failure Mode and Effect Analysis (FMEA)
6. Logic Tree Analysis (LTA)
7. Task Selection (Selection of maintenance policies)

1.2.4. Types of Treatment

There are 2 types of maintenance, namely Preventive Maintenance and Corrective Maintenance [11]

a. 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.
1. Time Directed Maintenance (TD) Preventive maintenance activities are 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.
2. 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.
3. Failure-finding maintenance (FF) is Preventive maintenance carried out by checking hidden functions periodically or as scheduled to determine when a component will fail.
4. Run Failure Maintenance (RTF) Maintenance activities that aim to find out when damage occurs by letting a tool operate until the tool is damaged

b. Corrective Maintenance

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) [12]

1.3. Research Objective

The research objective of this study is to determine the levying three (three) testing parameters: testing for e-maintenance methods/maintenance actions according to the damage category.

2. MATERIAL AND METHOD

The 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 is the reliability-centered maintenance (RCM) method. The stages of data analysis are system definition and initial information collection regarding QGS A1, 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 [12] The research flow chart can be seen in Figure 1.

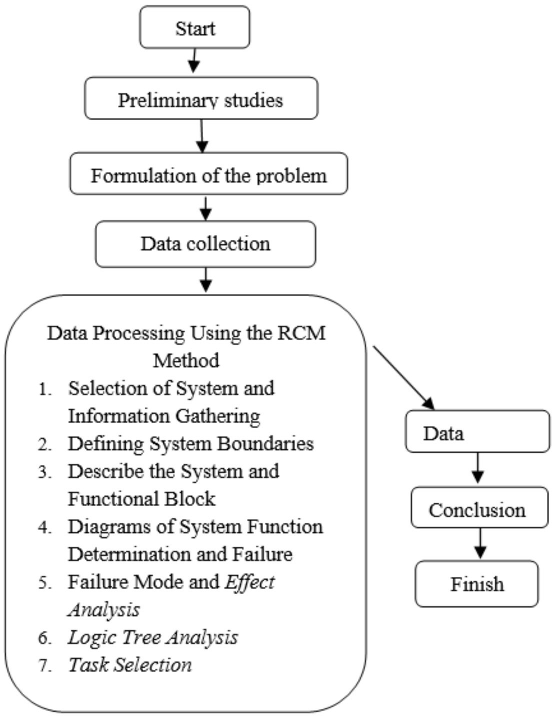

Fig. 1. Research flow chart

3. RESULT AND DISCUSSION

After identifying the engine, the breakdown frequency was obtained by calculating the damage from June 2022 to January 2023. Table 1. shows 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 that describes each system and equipment component, identifies all functions and interfaces with other systems or systems [13], and identifies all functional failures. Table 2 shows that if the functionality of the system and components has been determined, then a sequence of functional failures can be made [13].

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Table 1. QGS A1 Breakdown Frequency

No.	Item Breakdown	Frequency *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	Bolt replacement	1
11	*Repair elbow*	1
12	Total	98

Table 2. Determination of Component Function in QGS A1

No.	Machine Failure Description	System Failure Description	Component Failure Description
1	Hammer / Crusher does not operate	Unable to smooth the production of 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, and 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	A pile of dirt from combustion under the furnace	Chains break, sprockets 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 [14]. 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 [14].

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	-	√	-
12	Total	1	6	4

The compilation of logic tree analysis by determining the category of LTA components is obtained from interviews with maintenance technicians [15], as in Table 4. The following is the calculation for determining the percentage of components from each category:

Table 4. QGS A1 Component Category

No.	Category	Main component	Percentage (%)
1	A or D/A	1	9.10
2	B or D/B	6	54.54
3	C or D/C	4	36.36
Total		11	100.00

Table 4. It can be seen that there is 1 component (9.1%) that 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, 4 components (36.36%) are included in category C; the repair loss is relatively small if this component occurs. Next task selection is the last step in implementing the Reliability Centered Maintenance method [14]. This step also determines the maintenance strategy for the equipment that must be selected. The following is the maintenance system and the resulting actions with the Reliability Centered Maintenance approach as an action plan for each component [15]. Then, as can be seen in Table 5, the selection of QGS A1 mating action is divided into three categories: condition-directed, failure-finding, and run-to-failure [14].

Table 5. Selection of QGS A1 Treatment Measures

No.	CategoryTask Selection	Component	Percentage (%)
1	*Condition directed*	2	18.18
2	*Failure finding*	0	0
3	*Run to failure*	9	81.20
	Total	11	100.00

Table 5 shows that 9 components out of 11 components (81.2% of all components) 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. Equipment or machines are allowed to work until they are damaged, and then repair is carried out.

Based on the repair data 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 machine component's failure/damage mode. In the end, this categorization of actions can help companies minimize downtime, increase each machine's availability, 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 A1 is taking actions including Run to Failure. 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. There was 18.18% in the Condition Directed category, 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, which include finding hidden equipment damage, conducting periodic inspections, and obtaining special tools. The conclusion is that the damage that occurred was in the Run of Failure category 81.52% and Condition Directed 18.18%, so the appropriate maintenance method is to use the Condition Directed category to anticipate early damage by means of visual inspection.

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