



THE MAINTENANCE INTERVAL OF PREBREAKER CRITICAL COMPONENTS USING RELIABILITY-CENTERED MAINTENANCE IN PT XYZ

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ABSTRACT

PT XYZ is a crumb rubber company that produces SIR 10 and rubber smoke sheets (RSS). As the biggest crumb rubber-produced company in Indonesia PT XYZ makes the production process sustainable. The often problem in this company is machine breakdown that occurs downtime value to be high. The highest downtime value from October 2020 until March 2021 was the Prebreaker Machine whose total downtime value was 1875 minutes. The Reliability Centered Maintenance (RCM) method is used for decreasing downtime value. The RCM is integrated with Failure Mode Effect Analysis (FMEA) for analyzing The Highest Risk Priority Number (RPN). The research results that the optimal maintenance time of the Prebreaker Machine is 51 hours which means the Prebreaker Machine is maintained after operation for 51 hours.

Keywords: Preventive Maintenance, RCM, FMEA, Machine Downtime

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I. INTRODUCTION

The process production system is affected by the maintenance of equipment and machines. The maintenance process is all caring, repairing, and turnover for the plant facility to keep the production process on the planned. The squally production machine failure leads elevation of major downtime. Downtime influences the effectiveness and productiveness of the production system. SIR 10 and Rubber Smoke Sheet (RSS) are produced with various machines such as slab cutter, prebreaker, creeper, shredder, transfer pump, static separator, WL drier, metal detector, and balling press. The machine with the highest downtime value is a prebreaker. This machine chops the rubber surface to be wider. The prebreaker downtime from October 2020 to March 2021 was 1875 minutes which a breakdown frequency was 22 times.

The corrective maintenance can be done when the machine breakdown to avoid downtime. Once the corrective maintenance process needs 1.42 hours that means that corrective maintenance is not effective because needs a big cost for maintenance. The preventive maintenance application with age replacement method in Artha Prima Sukses Makmur was conducted in the sole shoe machine. The first step was finding critical machines and components. The process ends determined interval time for optimal maintenance that can alleviate downtime was 2,8% and 38% maintenance cost (Praharsi et al, 2015).

Based on previous research and actual condition in PT XYZ, then research needs to be done for production machines in order for downtime value can be decreased. One of the methods that can be adopted to solve this problem is preventive maintenance scheduling to prevent machine downtime along the production. Reliability Centered Maintenance (RCM) is a maintenance management method that is planned and proactive avoiding

functional system failure. RCM focus on activities that have a big impact on system performance. Maintenance and failure history data are used to determine failure rate value, and the reliability index then calculates Mean Time to Failure (MTTF) to quotation maintenance interval.

II. METODE PENELITIAN

This research was developed in PT XYZ which produces crumb rubber. Primary data is critical for machines and components. Seconder data is the failure rate of critical components that are calculated being MTTF.

III. HASIL DAN PEMBAHASAN

3.1 Critical Component Determination

The critical component date is used to find downtime from October 2020 to March 2021. Downtime results in 14 production machines can be seen in graphic figure 1.

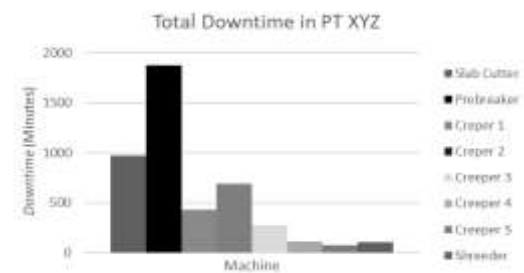


Figure 1. Total Down Time Graphic in PT XYZ

Based on figure 1 can be seen that from 14 machines only 8 machines have downtime from October 2020 to March 2021. The highest downtime was the prebreaker machine whose values were 1875 minutes or 31.25 hours. The prebreaker machine has been a critical machine in the production process. The critical components were determined with Failure Mode Effect Analysis (FMEA). The Risk Priority Number (RPN) was used to find the most critical component in the Prebreaker Machine. RPN results can be seen in table 1.

Table 1. Total of RPN Value from prebreaker machine

No	Components	Severity (1-10)	Occurent (1-10)	Detection(1-10)	RPN
1	Bearing	7	5	6	210
2	Gear Box	4	3	3	36
3	Spur Gear	5	3	5	75
4	Ban Conveyor	2	1	2	4
5	Fan- Belt	4	2	2	16
6	Block Bearing	6	4	5	120

7	Bushing	3	5	4	60
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Based on RPN values in table 1 was obtained that the critical component was the bearing component which the highest value is 210. This result draws bearing failure that can be a serious problem for the Prebreaker Machine.

3.2 Component Failure Index Determine

The failure of the Prebreaker Machine was because of the bearing component which does not work well. The time to failure in bearing component was 241,22; 267,32; 134,7; 157,61; 502,26; 220,41; 253,59.

3.3 Determine Maintenance Time Interval

The maintenance interval is aimed at setting maintenance scheduling and component replacement. The result of the distribution is Mean Time to Repair (MTTR) and Mean Time to Failure (MTTF). The kind of data distribution is decided by the lowest AD value.

The lowest AD Value for TTR is the lognormal distribution pattern which a value is 1.501 and the TTF is the Weibull distribution which a value is 1.68.

3.4 Mean Time to Repair (MTTR) and Mean Time to Failure (MTTF)

Calculation

MTTR and MTTF calculation for critical components obtained are Tmed = 1,244 and S = 1,06534 so the time to repair is as follows:

$$\begin{aligned} \text{MTTR} &= T_{\text{Med}} \cdot e^{(s^2/2)} \\ &= 1.244 \times 1.06534 \\ &= 2.19 \end{aligned}$$

The Mean Time to Repair (MTTR) in the bearing component is 2.19. The result of the calculation of Mean Time to Failure (MTTF) for bearing components with Weibull distribution can be seen in figure 2.

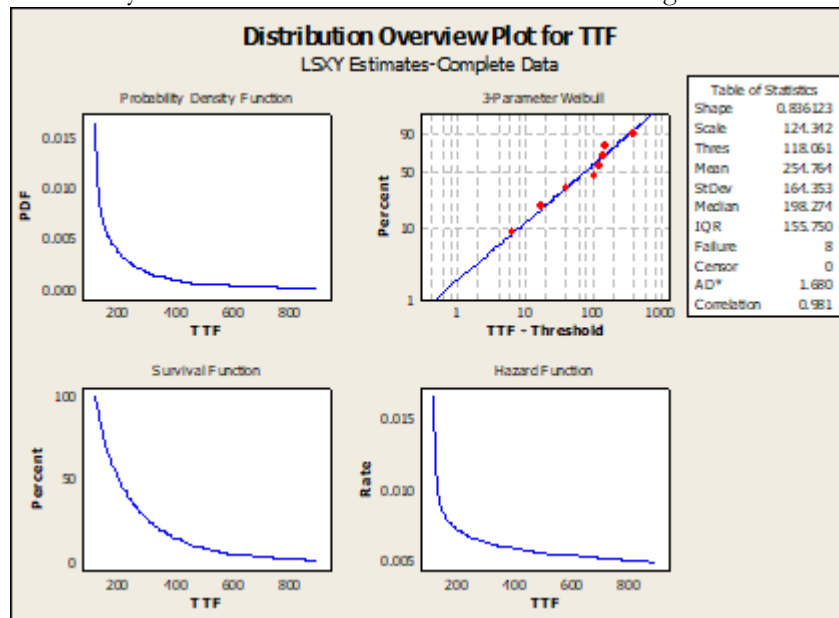


Figure 2. Failure Rate Curve (MTTF)

Based on the failure rate curve for the bearing component obtained $\theta = 124.342$ and $\beta = 0.3612$, The failure function for the first time decreases 254th time and increases every increasing time. The Mean Time to Failure (MTTF) of the Bearing component is as follows:

3.5 Reliability of Bearing Component

The reliability of the bearing component is calculated for performance probability supposedly. The result of bearing component reliability is as follows:

$$\begin{aligned} \text{MTTF} &= \theta \cdot (1 + 1/\beta) \\ &= 124.342 \times (1 + 1/0.3612) \\ &= 136.227 \end{aligned}$$

The MTTF result of the Bearing component is 136.227 or 136 hours.

$$\begin{aligned} R(t) &= e^{-(t/\theta)^{\beta}} \\ &= e^{-(2.7183)^{-(136/124.324)^{0.8361}}} \\ &= 0.3270 \end{aligned}$$

The reliability value is 0.327 or 32.70% when the bearing component runs for 136 hours which means reliability which is 32.70%. This reliability percentage is quite low so is needed failure probability calculation. The result of the bearing component failure probability is:

$$\begin{aligned} f(t) &= 1-R(t) \\ &= 1-0.3270 \\ &= 0.673 \end{aligned}$$

The failure probability of the bearing components is 0.673 or 67%. The bearing component failure value is still high, so needed maintenance time calculation for decreasing downtime with age replacement model. The failure probability value simulation uses time from 50 to 136 hours. The most optimal result is the smallest $D(T_p)$ value in time for time 51 minutes as follows:

$$\begin{aligned} D(T_p) &= \frac{(T_p.R(tp)+T_f(1-R(tp)))}{((tp+T_p).R(t)+(Mtp+T_f)(1-R(tp)))} \\ &= \frac{(51 \times 0.6113) + (2.19(1-0.6113))}{((1.19+51) \times 0.6113) + (350.4682 + 2.19)(1-0.6113)} \\ &= 0.189532 \end{aligned}$$

The result of $D(T_p)$ is meant the least failure 51st time. The bearing failure probability is 0.1895 or 18.95%. The machine reliability reaches 81.05%

IV. CONCLUSION

The identification results of the critical component in PT XYZ are the Prebreaker Machine whose downtime is 1875 minutes. The most critical component in the Prebreaker Machine is the bearing component whose RPN value is 210. MTTR value is obtained 2.19. The Mean Time to Failure is 136 hours. The Reliability value is 32.70%, so this result is still very low. The failure probability of the bearing component is 67.30%. Based on the analysis result the time for optimal maintenance of the Prebreaker Machine is after the machine operating for 51 hours which makes failure probability decrease by 18.95% and the reliability value increase by 81.05%.

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