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Implementation of MTTR and MTBF for Determining the Average Maintenance Interval of Press Machines at PT X

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Abstract

The independent internship program at PT X aims to apply Industrial Engineering concepts in a real industrial environment, particularly in the field of machine maintenance. This study focuses on analyzing the reliability of the press machine at Lane Kiln 2, which plays a crucial role in the ceramic production process. The methods used in this analysis are Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR) to evaluate the frequency of machine failures and the efficiency of repair time. Based on the data processing results presented in Chapter III, the MTBF value obtained is 703 minutes approximately 12 hours, and the availability of the press machine at Lane Kiln 2 is 93.64%. These results indicate that the machine availability level is relatively high and capable of supporting smooth production operations. However, the findings also suggest that although the repair process has been carried out effectively.

Keywords: *MTTR, MTBF, Maintenance, Mchine Reliability, Reliability Analisys*

1. Introduction

The increasingly competitive manufacturing industry demands that companies maintain reliable, efficient, and sustainable production systems. Increasing market demand, global competition, and the demand for high product quality encourage companies to optimize all available resources, particularly in terms of production equipment and machinery. Under these conditions, machine reliability is a key factor in determining the smooth operation and achievement of company production targets. Furthermore, higher education is required to produce graduates who not only master theory but also possess practical and analytical skills in line with industry needs. Students need real-world experience to understand the real problems faced by companies and apply scientific concepts effectively. One effective form of learning to meet this need is through industrial internships. Internships provide students with the opportunity to be directly involved in company operations, understand work systems, and directly observe various technical and managerial issues. Through internships, students can apply the knowledge they have learned in college, particularly in the field of Industrial Engineering, such as production systems, maintenance management, machine reliability analysis, and improving operational efficiency. The internship program is also part of the Independent Learning (Merdeka Belajar Kampus Merdeka) (MBKM) policy, which aims to improve the competency, work readiness, and competitiveness of graduates through experiential learning in the industrial world [1].

PT X is one of the largest ceramic manufacturing companies in Indonesia, specializing in the production of floor and wall tiles. Founded in 1971 in Surabaya, PT X has grown into a national and international ceramic manufacturer with various leading brands such as Platinum and Asia Tile. The company's success in maintaining its existence and competitiveness is inseparable from the implementation of a modern, integrated production system supported by the use of large-capacity, high-tech machinery. The ceramic production process at PT X consists of several main stages: raw material preparation, pressing, drying, kiln firing, and finishing. All these stages are interdependent, so disruptions in one stage will directly impact the entire production flow. Therefore, every machine involved in the production process plays a strategic role in maintaining operational continuity and stability. One of the most crucial machines in the ceramic production process is the press, particularly the press operating in Lane Kiln 2. The press in Lane Kiln 2 compacts the ceramic raw materials before they enter the firing process, thus determining the product's initial shape, dimensions, density, and strength. Optimal press performance significantly impacts the quality of the firing results and the durability of the resulting ceramic products.

The Lane Kiln 2 press operates continuously at high pressure and high production capacity to meet the company's production targets. These operational conditions place the press under a high workload and pose a significant risk of component wear. If not properly maintained, the press can experience decreased performance, repeated breakdowns, and increased downtime. This can disrupt production schedules, reduce output, increase maintenance costs, and delay product delivery to consumers [2]. Machine breakdowns and production downtime are crucial issues frequently faced by manufacturing companies, including PT X. A Lane Kiln 2 press machine failure will interrupt production flow to the firing stage, creating a bottleneck in the overall production system. This situation not only impacts technical aspects but also impacts cost efficiency, labor productivity, and customer satisfaction. Therefore, a systematic evaluation of the performance and reliability of the Lane Kiln 2 press machine is necessary to minimize the risk of damage and improve the effectiveness of the maintenance system. Machine reliability analysis is an important approach to identifying damage patterns, optimal operating times, and the effectiveness of the company's repair processes. One common method used in machine reliability analysis is calculating the Mean Time Between Failure (MTBF) and Mean Time to Repair (MTTR). MTBF describes the average operating time of a machine.

2. Methods

2.1. Literature review

Machine maintenance is a crucial factor in controlling a company's operational costs. Reliability analysis of press units shows that determining the appropriate preventive maintenance interval can reduce cumulative downtime while lowering maintenance costs. Several studies modeling optimal maintenance intervals for press units concluded that critical components such as rolls, bearings, and burners contribute the most to downtime. Therefore, these components need to be scheduled for maintenance at intervals that minimize the total cost per unit time. The results of this study reinforce the importance of implementing a data-driven preventive maintenance strategy for press machines in the ceramics industry [3].

The ceramics industry is a manufacturing sector characterized by continuous production processes and high machine utilization rates. Press machines play a strategic role in the initial formation process of ceramic products, namely compacting and shaping the raw material before entering the firing stage. Press machine performance significantly influences the initial product quality, such as density, mechanical strength, and dimensional uniformity. Given that press machines operate under high pressure and undergo repeated operating cycles, component wear is relatively high, necessitating a planned and continuous maintenance system [2].

Machine reliability is defined as the ability of equipment to operate according to its intended function without failure within a specified timeframe and under specified conditions. Low machine reliability can disrupt production flow and increase maintenance costs. Therefore, reliability analysis is a crucial approach in production equipment maintenance management. Through this analysis, companies can identify failure patterns, determine appropriate maintenance intervals, and plan component replacements before failure occurs [4].

One of the key indicators in machine reliability analysis is the Mean Time Between Failure (MTBF), which indicates the average operating time of a machine before failure. A high MTBF value indicates good machine reliability and a low frequency of breakdowns. In the context of press machines, MTBF serves as the basis for determining maintenance intervals and spare part replacements. This information helps companies schedule preventive maintenance more accurately to prevent unplanned downtime [5].

In addition to MTBF, Mean Time to Repair (MTTR) is an important indicator that describes the average time required to repair a machine until it returns to normal operation. A low MTTR indicates an effective maintenance system, supported by technician readiness, spare parts availability, and clear repair procedures. Conversely, a high MTTR indicates bottlenecks in the repair process, which can prolong machine downtime and negatively impact company productivity [6].

MTF and MTTR are closely related in evaluating the overall performance of a maintenance system. These two parameters can be used to calculate machine availability, which is the probability that a machine is in operational condition. High availability indicates that the machine is capable of supporting the production process optimally and stably. Therefore, MTBF and MTTR analysis serve not only as a tool for evaluating machine reliability but also as a basis for strategic decision-making in determining maintenance policies [7].

Reliability studies on instrumentation and mechanical systems of press units or similar units also emphasize the importance of critical component analysis to maintain operational continuity. Research on press instrumentation units shows that identifying components most susceptible to failure is the first step in designing a Reliability Centered Maintenance (RCM) strategy [8].

2.2. Data collection technique

The data collection techniques used in this report were conducted systematically to obtain accurate and relevant data for the purpose of analyzing the reliability of the Lane Kiln 2 press machine. The data collection methods applied included direct observation, documentation, and interviews. Direct observation was conducted by observing the operational conditions of the press machine, the production process, and maintenance and repair activities carried out by technicians. Through these observations, the author obtained a real picture of the machine's work patterns, the types of damage that often occur, and the required repair time. Documentation was used to collect historical data on machine damage, downtime, repair time, and maintenance schedules recorded in the company's maintenance report. This documentation data became the main source in calculating MTBF and MTTR.

2.3. Data collection stage

The data collection phase was carried out in stages and systematically to ensure the data obtained was accurate and in accordance with the needs of the MTBF and MTTR analysis on the Lane Kiln 2 press machine at PT Platinum Ceramics Industry. This phase began with determining the research object, followed by field data collection until the data was ready to be processed. The initial phase was the identification of the object and research period, namely the Lane Kiln 2 press machine with a damage observation period of October 2025. After the object was determined, direct observations were conducted in the production area to understand the machine's operational conditions, workflow, and ongoing maintenance and repair processes. The next phase was the collection of historical data, obtained from company documents in the form of machine damage reports, downtime, repair time, and maintenance records. This data became the main basis for calculating the MTBF and MTTR. To complete and validate the data, interviews were conducted with operators and maintenance technicians to obtain information on the causes of damage and the corrective actions taken.

3. Result and Discussion

Based on the spare part failure data in October 2025, the press machine will be the focus of repair because it received the highest percentage of damage in October 2025. The following is the failure data on the press machine as attached below:

Table 1: Data table of average

Tgl	*Detail Problem*	Repair	MTTR	MTBF
10/02/2025	*Trouble Press*	Replace the platinum logo, replace the HD L4 fast roll exit motor	35	360
10/02/2025	*Trouble Press*	Lower trouble can't go up normally (technical repair)	143	1469
10/02/2025	*Trouble Press*	Continued technical improvements	480	4932
10/03/2025	*Trouble Press*	Continue repairing jammed charger, narrow body at RPR & KA 7 powder test	110	1130
10/03/2025	*Trouble Press*	Repair trapez cav 4 & replace lower cav 4 worn	33	339
10/04/2025	*Trouble Press*	Body kancrit entry HD	33	339
10/04/2025	*Trouble Press*	Body cracked L2 exit + up down exit lamination, powder silo clogged, cold oil piston pump alarm (pump dead)	157	1613
10/04/2025	*Trouble Press*	Continue repair of the cold oil alarm & powder late silo blockage	80	822
10/05/2025	*Trouble Press*	Change the Asian logo, the body of the Kancrit exit HD laminate	68	699
10/05/2025	*Trouble Press*	Trouble with the R1 roll motor jamming, the housing is worn out, replace 1 set, the body is piled up, C2 laminate & alarm	78	801
10/05/2025	*Trouble Press*	The body is cracked up and down exit, the body is broken up and down exit & the powder hopper is stuck late	13	134
10/06/2025	*Trouble Press*	Repair of broken and stuck countersunk bolts	83	853
10/06/2025	*Trouble Press*	Charger jammed, C2 piled up & FG cleaning	17	175
10/06/2025	*Trouble Press*	Alarm charger	2	21
10/07/2025	*Trouble Press*	Laminated body stacked on entry belt & maxtime alarm	94	966
10/07/2025	*Trouble Press*	Repair of front FB sensor charger alarm that is dead, stacking laminates & leveling up	96	986
10/07/2025	*Trouble Press*	Clogged powder hose repair	19	195
10/09/2025	*Trouble Press*	Alarm axis charger movement failure	97	997
10/09/2025	*Trouble Press*	Continue repairing the axis charger alarm	480	4932
10/10/2025	*Trouble Press*	Repair of axis charger alarm, replace valve (y1,y8,y13) trial program connection path PH 1 to HD 3	394	4048
10/10/2025	*Trouble Press*	Repair of RPR body cracks, lamination, powder late silo blockage	53	545
10/10/2025	*Trouble Press*	Trouble with axis charger alarm & laminated body	44	452
10/11/2025	*Trouble Press*	Stock powder is minimal	171	1757
10/11/2025	*Trouble Press*	Oil level alarm, stacked up down C2, stacked broken up down exit HD	39	401
10/15/25	*Trouble Press*	Repair of teapez cav 4 & narrow RPR body trobel	54	555
10/15/25	*Trouble Press*	Repair of clamped body at RPR	41	421
10/15/25	*Trouble Press*	Oil level alarm, T belt broken	48	493
10/16/25	*Trouble Press*	Replace the plain lower, repair the loose R4 T belt + replace the tensioner pulley & trouble with the motor breaking	70	719
10/16/25	*Trouble Press*	Alarm oil level	39	401
10/19/25	*Trouble Press*	Trial PH 1 supply HD 3 deck repair, Setting line on the go & body cracked in F5	6	62
10/19/25	*Trouble Press*	Repair of R3 roll sensor & body often stuck in R2	33	339

Tgl	*Detail Problem*	Repair	MTTR	MTBF
10/19/25	*Trouble Press*	R3 Trouble & Late Powder	13	134
10/20/25	*Trouble Press*	Change platinum logo & Trial PH 1	18	185
10/20/25	*Trouble Press*	Stacked in updown C1, HD entry kancrit & stacked in updown C2	12	123
10/20/25	*Trouble Press*	Replace lower cav 3 & vanbelt updown C1 broken	33	339
10/21/25	*Trouble Press*	PH 1 supply road HD 3, trouble with cracked body on side D, body is cracked & line connection is dead + repair	55	565
10/21/25	*Trouble Press*	Body piled up at uptodown exit, PH 1 stop changing to PH 4	34	349
10/21/25	*Trouble Press*	The body is broken, the L2 exit & oil level alarm	13	134
10/22/25	*Trouble Press*	Setting the PH 1 to HD3 line connector to overcome cracks, breaks, broken C1 vanbelts, replace new ones & replace the platinum logo	43	442
10/22/25	*Trouble Press*	Oil level alarm, T belt roll R2 worn out, replaced with new one, body stacked entry HD body cracked	34	349
10/22/25	*Trouble Press*	Repair of R2 PH4 roll sensor error & stacking in updown C2	78	801
10/23/25	*Trouble Press*	Repair of T belt support exit HD, PH 1 transportation line level, fix cracks	44	452
10/23/25	*Trouble Press*	Trouble with the T belt up down C1 PH4 breaking, replace with a new one	25	257
10/23/25	*Trouble Press*	Kancrit body step by step entry HD & turn lower cav 4	7	72
10/24/25	*Trouble Press*	Repair oil leak in valve area Y13, replace pull roll C1 & replace up and down bend	48	493
10/24/25	*Trouble Press*	Roll repair before RPR, C1 up down trouble & oil level alarm	25	257
10/24/25	*Trouble Press*	Repair the P3+P4 connection panel trip & replace the C1 up down motor	81	832
10/25/25	*Trouble Press*	Trouble with the front C1 PH4 vanbelt updown broken & the HD entry body is broken	10	103
10/25/25	*Trouble Press*	Oil level alarm & clogged powder hose	31	319
10/26/25	*Trouble Press*	Setting upper cav 2, rotobelt C1 broken & pulley C1 shifted	101	1038
10/26/25	*Trouble Press*	Troubleshoot R4 tensioner pulley, remove, replace with new one & oil level alarm	20	206
10/27/25	*Trouble Press*	Kancrit roll R3, stack line connection, trial PH4 & cross sensor troubleshoot up and down C1	75	771
10/27/25	*Trouble Press*	Troubleshoot up down cross sensor C1 & replace up down gearbox C1 PH4	95	976
10/27/25	*Trouble Press*	Kancrit entry HD, alarm oil level and sorok rubber level	17	175
10/28/25	*Trouble Press*	Kancrit updown C1 & fix support updown C1	11	113
10/28/25	*Trouble Press*	Alarm oil level	8	82
10/28/25	*Trouble Press*	Alarm oil level	10	103
10/29/25	*Trouble Press*	Troubleshoot C1 sensor & replace platinum motif	10	103
10/29/25	*Trouble Press*	Change Asian motif	20	206
10/29/25	*Trouble Press*	Replace T belt R3	23	236
			4104	42169

Table Data table of average values of time between maintenance and time between failures in October 2025 at PT X The machine works normally for 24 hours non-stop, it is assumed that the machine stops for 4 days, namely on Sunday because no employees come in on that day, the total machine does not operate for 4 days which is calculated in minutes, namely 5,760. For 27 days of operation, the total machine operation for 1 month is 38,880. by obtaining the Total Operation Time, the calculation for Availability is:

$$Availability = \frac{42.169-5.760}{38.880} x\ 100\% = 93{,}64\% \quad (1)$$

From the availability calculation results obtained the result of 93.64%. The standard machine works optimally is 90%. So it can be said that the press machine works quite optimally and effectively. Therefore, to anticipate damage to critical components, it is necessary to carry out a maintenance scheduling system or just a better and structured check. In order to reduce the breakdown time that often occurs in the lane kiln 2 press machine as a production support. Based on the damage data of the lane kiln 2 press machine during the period of October 2025, the mean time between failure (MTBF) and mean time to repair (MTTR) can be calculated as follows:

$$\text{MTBF} = \frac{42.169}{60} = 703\ minutes \quad (2)$$

$$\text{MTTR} = \frac{4104}{60} = 69\ minutes \quad (3)$$

Based on the results of the mean time between failure (MTBF) calculation above, it was obtained 703 minutes. If one hour is equal to 60 minutes, then the preventive maintenance schedule for oil crosscheck and cleaning area of the lane kiln 2 press machine is 11.71 hours => 12 hours or equivalent to half a day, meaning that oil crosscheck and cleaning area of the lane kiln 2 press machine are carried out periodically every day for 2 times. The low MTBF calculation results indicate that the press machine has a less than optimal level of reliability so the company needs to improve its maintenance strategy. Preventive maintenance activities must be carried out more frequently with a time interval shorter than the MTBF value, which is less than 12 hours, and focused on components that experience the most frequent damage such as the press cylinder, mold, and hydraulic system. In addition, the implementation of predictive maintenance is also needed through monitoring machine conditions based on technical indicators such as hydraulic pressure, oil temperature, and piston vibration, which can be supported by the installation of vibration sensors and oil condition monitoring to predict damage before it occurs. The company also needs to improve the effectiveness of spare part management by including frequently damaged components into the fast-moving category and increasing safety stock to avoid delays in repairs due to limited spare part availability. Rescheduling maintenance activities based on failure patterns should be implemented, including conducting more in-depth inspections after the machine has been operating for more than 10 hours. By implementing these strategies, it is hoped that downtime can be minimized, machine reliability can be increased, and production processes can run more stably and efficiently.

4. Conclusion

Based on the MTBF and MTTR analysis of the press machine failure data for the period of October 2025, the availability value of the lane kiln 2 press machine was 93.64% and the MTBF value was 703 minutes or approximately 12 hours, indicating the need for preventive maintenance twice a day. Damage prone points were identified in the sensors, belts, and up-down systems. Therefore, it is recommended to schedule maintenance every 12 hours, increase oil inspections, check belts, and monitor sensors regularly. The implementation of these recommendations is expected to significantly improve machine reliability and minimize production downtime.

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