Production Machine Maintenance Analysis Using the Failure Mode and Analysis Method and Logic Tree Analysis at PT Symgreen Gresik

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Abstrak

Perawatan mesin produksi merupakan pengendalian produksi untuk menjaga produktivitas proses produksi. PT. Symgreen merupakan perusahaan yang memproduksi stick ice cream. Untuk mencapai hasil optimal dibutuhkan perawatan mesin secara berkala. Terjadinya kerusakan mesin produksi yang dialami selama proses produksi mengakibatkan beberapa kerusakan komponen mesin, sehingga hasil produksi berkurang. Metode Failure Mode and Effect Analysis digunakan untuk mengidentifikasi moda kegagalan dan mengatasi failure mode dalam setiap kerusakan mesin. untuk mengetahui katogori failure mode terhadap langkah perbaikan yang harus segera dilakukan serta arah tindakan yang harus dipilih untuk mengatasi failure mode digunakan LTA (Logic Tree analysis). Hasil analisis menunjukan terdapat 4 mesin dan 2 Jenis kerusakan berdasarkan komponen mesin produksi yaitu mesin potong permasalahannya di bearing yang pecah dengan RPN 144 masuk kategori B, gear mesin rotary retak nilai RPN 125 kategori B, spindel mesin rotary macet nilai RPN 125 kategori B, mesin gear champering pecah nilai RPN 120 kategori B, gear mesin cetak retak nilai RPN 125 kategori C. Usulan perbaikan dengan melakukan perawatan terhadap komponen mesin secara berkala, menyusun manual kerja pada setiap mesin.

Kata kunci: *Moda Kegagalan, Mesin Produksi, FMEA, LTA, RPN.*

Abstract

Maintenance of production machines is a production control to maintain the productivity of the production process. PT. Symgreen is a company that produces ice cream sticks. To achieve optimal results, regular machine maintenance is required. The occurrence of damage to the production machine experienced during the production process, in some damage to machine components, so that production results were reduced. The Failure Mode and Effect Analysis method is used to identify the failure mode and overcome the failure mode in every machine breakdown. To determine the failure mode category for the corrective steps that must be taken immediately and the direction of action that must be chosen to overcome the failure mode, LTA (Logic Tree analysis) is used. The results of the analysis showed that there were 4 machines and 2 types of damage based on the components of the production machine, namely the cutting machine the problem was in a broken bearing with RPN 144 in category B, rotary engine gear cracked RPN 125 category B, rotary engine spindle stuck RPN 125 category B, engine champering gear broke RPN 120 category B, printing machine gear cracked RPN 125 category C. P roposed repairs by performing regular maintenance on machine components, compiling work manuals on each machine.

Keywords: *Failure Mode, Production Machine, FMEA, LTA, RPN.*

1. Introduction

PT. Symgreen is a company that produces ice cream sticks in Gresik . Production carried out for meet industrial needs ice cream can be met, all of which almost use machines in the production process. Machines are the main tool in the manufacturing production process, measurable production results are expected to be able to meet product demand [1] . Ice cream stick production process using 9

machines consisting of cutting machines, rotary machines, printing machines, drying machines, polishing machines, ice cream stick styling machines , champering machines, sorting machines, bundle machines . Every machine production ice cream sticks at PT. Symgreen have role important for produce something expected product . _ Maintenance and checking machine production by periodically for guard quality the resulting product during the production process walk [2] .

Production machines at PT. Symgreen that is used continuously every day needs to be monitored and checked to find out the condition of the machine. Damage to facilities and machines due to irregular maintenance can harm the company, not only loss of production but also expensive repair costs that also endanger people around and workers. If machines and equipment are regularly maintained, it will provide benefits for the company, so that efficiency and production costs can be maintained [3] . Care machine very needed for avoid damage and loss company . Care is step in reduce potency happening source danger [4] . For know reason machine experience damage as well as know most influential failure on machine , then used FMEA (Failure Mode and Effect Analysis) method [5] . FMEA too could used for determine priority and repair machine done _ company [6] . Whereas for know category failure mode to step must repair _ quick done as well as direction necessary action _ chosen for overcome failure mode used LTA (Logic Tree analysis) [7] . LTA too used for choose action and determination pattern repair machine [8] . Objective study is know type damage component machine production and business reduce damage machine production with use with use FMEA and LTA methods .

Care is activities carried out for look after condition something tool and facility so that working with [9] . Failure Mode And Effect Analysis (FMEA) is method used _ for identify potency happening fashion failure [10] . FMEA is used for measure level failure production with use Risk Priority Number (RPN) [11] . There is three measurement used _ in the FMEA process that is mark severity (S) for measure level damage , value occurance (O) measure level failure , value detection (D) ability detect happening failure . Results from multiplication the value of S, O, D will be used for for know Risk Priority Number (RPN) [12] .

Logic Tree Analysis (LTA) is a method for classifying failure modes by grouping them into certain categories so as to simplify the task of machine maintenance [14] . LTA is a mapping failure mode based on consequences , goals _ _ from LTA gives priority to each failure mode and review how much failure function that . Category criticality in LTA divided Becomes four namely (1) Category A (safety problem), failure mode caused the disturbance operator safety and environment ; (2) Category B (outage problem), resulting in happening failure part or all system result in loss cost ; (3) Category C (economic problem) is not have impact safety and disturbance system , but result in loss economy scale small ; (4) Category D (hidden failure), difficult detected because not seen by operator directly direct [15]

2. Method

Study started with observation to object research , continued observation beginning for know total machine and fashion failure happened _ to machine production . Next identify reason happening fashion failure , compose FMEA questionnaire for get mark Severity, Occurance , Detection with a rating of 1 to 10. Step next count RPN value obtained from results multiplication value of S x O x D. Next RPN calculation , to find out priority repair . Data processing continues use Logic Tree Analysis (LTA), each fashion failure classified Becomes three category criticality analysis that is evident, safety, outage . Category next shared Becomes four type in accordance category LTA criticality . results end from study this is proposal repair care machine production ice cream sticks .

3. Results and Discussion

Data collection on condition machine production there are several machines used in the production process at PT. Symgreen, a description of each function the use of each machine production as follows.

Table 1. Machine Production and Function

No	Machine name	Description
1	Cutting machine	Wood cutter to make wood into size 42 cm
2	*Rotary* Machine	Turning wood into sheets before entering the press
3	Printer	Make wood into a pattern / shape into ice cream sticks
4	Dryer (Caddy)	Drying molded ice cream sticks
5	Smoothing machine (*polishing*)	Reduces the remaining wood chips
6	Ice cream stick machine	Arrange the ice cream sticks before taking them to the champering
7	champering machine	Blunt the sides of the ice cream stick so they are not sharp
8	sorting machine	Picking and sorting good and bad ice cream sticks
9	Bundle Machine	Fastening of ice cream sticks before packaging

After obtained description name machine ice cream stick production , next done identification fashion failure and reason happening failure .

Table 2. Failure Mode and *Failure Cause* on Machine Production

No	Name	*Failure Mode*	*failure cause*
1	Cutting machine	a. worn dynamo b. chainsaw v-belt connection separated c. broken bearing d. broken v-belt	a. the amount of dirt that goes into the dynamo b. connection is rusty c. lack of lubrication d. installation is too tight
2	Rotary Machine	a. cracked knife bolt b. spindle jam c. broken v-belt d. cracked gear	a. hit by wood knots and nails b. lack of lubrication c. V-belt worn d. the material used is not good
3	Machine print	a. stuck bearing b. cracked gear c. bearing bolt broken d. V-belt worn	a. lack of lubrication b. too pushy to install c. the bolt has passed the saturation point d. scratched with objects around
4	Dryer (Caddy)	a. short circuit b. worn dynamo	a. lack of cleaning b. spool on fire
5	Smoothing machine (*polishing*)	a. broken polishing chain b. conveyor chain dislodged c. worn dynamo	a. lack of lubrication b. chain too loose c. spool on fire
6	Ice cream stick machine	a. broken conveyor b. V-belt dislodged	a. loose connection b. too loose
7	*champering* machine	a. worn dynamo b. broken v-belt c. broken gear d. short circuit	a. spool on fire b. V-belt is already thin c. too forceful use d. loose cable
8	sorting machine	a. broken chain b. dynamo stuck	a. lack of lubrication b. dislodged spool bolt
9	*Bundle* Machine	a. broken v-belt b. error button	a. V-belt is already thin b. loose cable

From table 2. then make an assessment of the failure mode with FMEA table containing *severity* (S), *occurrence (O)* and *detection* (D). after assessing each *failure mode* with FMEA table , then calculate the value of the *Risk Priority Number* (RPN).

Table 3. Evaluation *Failure Mode* and RPN Value

No	Name	*Failure Mode*	S	O	D	RPN
1	Cutting machine	Dynamo Aus	5	4	3	60
		Broken Saw V-Belt Connection	3	4	2	24
		Bearing Broken	8	6	3	144
		V-Belt Broken	3	3	2	18
2	*Rotary* Machine	Cracked Knife Bolt	4	4	5	80
		Spindle Jam	5	5	5	125
		V-Belt Broken	3	4	4	48
		Cracked Gear	5	5	5	125
3	Printer	*Bearing* Jam	5	4	4	80
		Cracked Gear	5	5	5	125
		Bearing Bolt Break	4	4	3	48
		V-Belt Aus	4	4	4	64
4	Dryer Machine (Caddy)	Shortcut Panel	4	4	5	80
		Dynamo Aus	5	4	4	80
5	Smoothing Machine (*Polishing*)	Polishing Chain Break	4	5	4	80
		Dismounted Conveyor Chain	4	4	4	64
		Dynamo Aus	5	4	4	80
6	Ice Cream Stick Machine	Disconnected Conveyor	4	4	4	64
		V-Belt Dislodged	4	4	3	48
7	*Champering* Machine	Dynamo Aus	4	4	4	64
		V-Belt Broken	4	4	3	48
		Broken Gear	5	4	6	120
		Short circuit	4	5	4	80
8	Sorting Machine	Broken chain	4	4	4	64
		Dynamo Jam	5	4	4	80
9	Bundle Machine	V-Belt Broken	4	3	5	60
		Error Button	4	5	4	80

Calculation from RPN value of table on is known that highest RPN value i.e. 144 for lay down broken on machine cut . For know category from every *failure mode* to step must repair _ done as well as direction action , then used *Logic Tree Analysis* (LTA).

Table 4. Results *Logic Tree Analysis*

No	*Functional failure*	*Failure Mode*	*evidence*	*Safety*	*outage*	*Category*
1	Cutting machine	Broken *bearing*	yes	no	yes	B
2	*Rotary* Machine	Gear cracked	yes	no	yes	B
3	*Rotary* Machine	Spindle stuck	yes	no	yes	B
4	Machine *champing*	Broken gear	yes	no	yes	B
5	Printer	Gear cracked	yes	no	no	C

From result identification failure obtained necessary failure *mode* applied in Thing the treatment . Following is table suggestion repair in care machine production at PT Symgreen for every *failure mode.*

Table 5. Suggestion Repair

Failure Type	*failure Cause*	*RPN*	*Category of LTA*	Improvement Proposal
Cutting machine	*Bearing* Broken	144	B	Correct scheduling of bearing replacements
Rotary Machine	Cracked Gear	125	B	Check and provide lubrication when the lubricant runs out
Rotary Machine	Spindle Jam	125	B	The operator should check if there are signs of damage when the machine is operating
Champering Machine	Broken Gear	120	B	Make soup for periodic checks thorough every few times very
Printer	Cracked Gear	125	C	Doing checks, not forcing the machine to keep running and immediately replacing if you know a crack has occurred

4. Conclusion

Based on results discussion so concluded that There are 4 machines and 2 Types damage based on component machine production . First machine cut , the problem is in the broken bearing and has the highest RPN i.e. 144 and enter in type / category B (*outage problem*), second machine *rotary* is the problem on the cracked gear own RPN value of 125 and enter in type / category B (*outage problem*), third machine problematic *rotary* in the jammed spindle _ and own RPN value 125 in in type / category B (*outage problem*), fourth Machine Champing experience damage in broken gear , has the value of RPN 120 which is type / category B (*outage problem*) and final machine print , experience damage cracked gear part own the value of the incoming RPN 125 in type / category C (*economic problem*) . Suggestion repair with To do scheduling replacement on all component especially on frequent components _ experience damage . Operators are given briefing in operation machine in accordance with book guidelines , prioritizing profession repair / replacement component if occur damage in accordance RPN value .

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