Implementation MTBF (Mean Time Between Failures) to Reduce Cost of Maintenance Painting Line& Product Defect at Sparepart Accessories Factory

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Abstract:- The end result of a product is accepted by the consumer, sold and sold. One way for the product to be accepted by the consumer is an attractive appearance that is by painting. in large-scale production of painting process with semi automatic and even automatic equipment. Painting line is a set of painting appliances that operate automatically. To be optimally required periodic maintenance. In this study calculated RCM (Reabilty Cost Maintenance) of unscheduled care with the scheduled. Preparation of preventive maintenance schedule based on RCM assessment on the painting line machine can increase the value of MTBF (Mean Time Between Failures) so as to increase reliability, reduce defective product by 75%, save the cost of Rp 15,616,224,000 per year, reduce the time to repair up to 95% so that machine can operate optimally and help improve company productivity.

Keywords:- *Paintingline, Reabilty Cost Maintenance. MTBF.*

I. INTRODUCTION

The end result of a product is accepted by the consumer, and sold. One way that the product is accepted by the consumer is an attractive appearance. In order to display the product can be good and interesting can be done painting finishing with color and texture good. Maximum painting results can be achieved when using good materials, well maintained equipment and good painting performance in accordance with the standards.

In large-scale production the painting process has not been done manually but it has been done with semi-automatic and even automatic equipment.In the process of automatic painting required equipment that can perform continuous painting in a long time and maintained the quality of the painting results from paint damage such as over spray, the paint is not merat, then it is necessary care of painting equipment that is scalable and planned.

In this research will be studied painting equipment design on product which is special line that is line painting with method of RCM (Reliability Centered Maintenance).

II. PAINTING

Painting is the process of coating a medium such as, Plastic, Metal, Metal with coating or paint that serves as a coating to protect the media from rust or to beautify the exterior and interior of an object.

In the automotive painting industry becomes a very important thing to get an attractive appearance for the product in demand by consumers. But in the painting there are many obstacles that are done, among others, as follows.

- *Seeding*

This problem is relatively mild if the spots are small but will be heavy if the diameter of the speck is large and many, its will take a lot of time for the repairing process. This problem can be from dirty environments, sparse sparguns or paint materials contaminated with dust or other dirt

- *Createering*

Createering classified as a medium problem because it could be done repainting all the media or just in the area that creatring it depends on the severity. Createering is caused by contamination between paint and water or oil.

- *Orange Peel*

Orange peel is a problem of less spraying applications or viscosity of paint is too thick. This looks like a coat of orange peel.

- *Coarse is the surface*

Coarse is the surface of the less clear coat applications. This is because the layer that should be 3 layers is reduced to 2 layers while the setting of spraygun and viscosity is set 3 layer or application on clear unstable coat.

- *Motling*

Motling is caused in the application of unstable base coat or viscosity is not appropriate so that the color of the field in painting to be striped or different colors. This problem includes severe problems due to repainting

- *Sagging*

Sagging caused by the distance between the sprayed field and the spraygun is too close or the viscosity is too low.

- *Dent*

This problem is a serious problem. because this problem is in the field to be painted its shape like concave on the surface of the field. repair of this problem is difficult. if this problem occurs in the plastic heat the convex field with the metabo or the like while pressed from the opposite field if the metal process requires a process of beatingfrom the opposite field or putty from surface.

III. PAINTING LINE

Line Painting is a system of painting integrated with modern systems for industrial goods that produce quality, and quantity of satisfactory production. In general, this painting system consists of Spray Booth spaces that are dust-free painting room, with air and humidity regulation that produces the perfect paint color. This room can be set at a certain temperature as per the paint specifications.

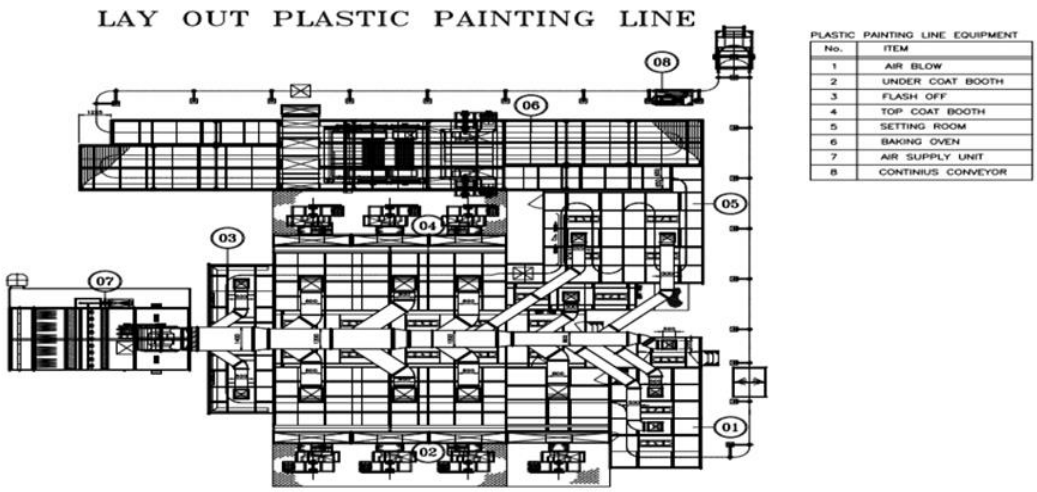

Fig 1:- Lay out Plastic Painting Line

Here is an explanation of the supporting equipment Painting Line .

- *Air Blow Chamber*

Air Blow is the first stage done before painting process, where at this stage workpiece / media to be in paint must pass this stage to avoid dust which will become defect at welding result.

- *Under Coat Booth (Spraybooth)*

Under Coat Booth / Spray booth is an early stage in doing painting workpiece / media. Where Spraybooth itself is a closed room, to do the painting of workpieces, where pressure, cleanliness and air flow inside are arranged. This setting is to condition the room to be optimal for painting.

- *Flash Off Chamber*

Prior to the Top Coat process there is a room called Flash Off where this room serves as the evaporating chamber of part or all of the volatile paint portion prior to the formation of the finished film and / or before further coatings can be applied.

- *Top Coat Booth (Spraybooth)*

Top Coat Booth / Spray booth is the final stage. Generally this stage is the final staining stage in the painting.

- *Setting Room Chamber*

Setting Room Chamber is the room where a painting process has been done as a whole and the workpiece will enter the next process ie the heating process (oven).

- *Baking Oven*

Baking oven is a drying chamber with adjustable temperature to speed up the paint drying process and the resulting color becomes more radiant.

- *Air Sipply Unit*

Air Supply Unit is Equipment used to supply clean air from outside to fill the air of rooms that exist in line painting. Air supply unit is very influential on the results of painting.

- *Continous Conveyor*

Conveyorsystems are mechanical devices that move to move materials from one location to another made by hanging from above. The conveyor system enables fast and efficient transportation for a wide range of materials, which makes this tool very popular in the industry.

IV. RCM (RELIABILITY CENTERED MAINTENANCE)

Reliability is defined as the possibility that a system or product may operate at satisfactory conditions over a certain period of time when used under operating conditions determined by the work environment (Moubray, 1991).

Reliability is determined by 4 factors: (1) probability, (2) satisfactory / expected performance, (3) and (4) operating conditions.

➢ *Reliability Centered Maintenance (RCM) Benefits*.

There are several benefits for the company if RCM implemented.

- Improving operating performance, so as to produce a quality product.
- Improve safety and protection of the work environment.
- Efficiency to maintenance cost.
- Extend the life of equipment and machines, especially machines with high cost.
- Fixed the database system in the maintenance department, so it can be more organized.
- Improve cooperation among employees and motivate individuals to work better

V. MTBF(MEAN TIME BETWEEN FAILURES)

MTBF analysis (Mean Time Between Failure) is done by changing the data TBF (Time Between Failure) so that it will affect the type of distribution damage. If TBF (Time Between Failure) remains (constant) then the distribution of the damage is exponential. If TBF (Time Between Failure) is small then it will produce MTBF (Mean Time Between Failure) which is small value so it will affect the cost of component replacement or component repair.

Repair Time or Mean Time To Repair (MTTR) is the average time required to perform a repair by a machine (Limantoro, 2013). MTTR can be calculated by the following equation.

$$RepairTime = \frac{TotalRepairTime}{NumberofRepair}$$

Mean Time Between Failure (MTBF) is the average time interval of damage that occurs when the machine finishes repair until the machine is damaged again(Limantoro, 2013). MTBF can be calculated by the following equation.

$$MTBF = \frac{TotalTimeBetweenFailure}{NumberofFailure}$$

Preventive Maitenace (PM) is the treatment of an equipment performed to prevent the occurrence of brekdown. PM is carried out continuously and periodically and with special treatment in accordance with the specifications of the equipment. Preventive maintenance, is part of the PM that predicts a possible damage to equipment through continuous and periodic inspections. Failure Rate is the rate at which the damage occurs at defined time intervals is called the rate of damage at that interval (Suprianto, 2018). Speed rate (λ), formulated.

$$\lambda = \frac{NumberofFailure}{TotalTimeOperation}$$

Maintenance costs are divided into the cost of repair or replacement of defective parts and maintenance work, which is taken from the average hourly rate at times with the amount of labor and maintenance time for maintenance labor costs (Suprianto, 2018).

Defective products are technically or economically flawed products that can still be repaired into products that conform to the established quality standards but require additional costs (Herawati& Lestari, 2012). Defective products are the goods produced can not meet the established standards but can still be fixed (Kholmi&Yuningsih, 2009). The defective product is a product produced in the production process, where the resulting product is inconsistent with the specified quality standard, but can still be fixed by incurring certain costs (Bustami&Nurlela, 2007).

In the production process, this defective product can be caused by two things, namely: caused by the specification of the buyer (abnormal) and caused by internal factors (normal). The problem that arises on this defective product is the treatment of rework of the defective product if it is abnormal it will be charged to the production cost of the order in question. Whereas if the defective product is normal, then the reworking cost is treated as factory overhead cost. For those companies that use the rates set forth in charging factory overhead costs to the product, the estimated cost of redesigning the defective product becomes the element of determining the overhead factory tariff (Herawati& Lestari, 2012).

If in the production process there are defective products, the problem that arises is how to treat the defective product, if sold and if not sold. Accounting Treatment for defective products (Mursyidi, 2008), namely.

- Reworking costs are added to the cost of the order
- Added on factory overhead
- Added on defective product loss

In the production process, in the event of defective products will be taken into account along with the cost of rework.

$$\text{Product Cost Defect Raw Price} = \frac{\text{Total Cost} + \text{Reworking Cost}}{\text{Defective Product}}$$

VI. DATA PROCESSING

The application of RCM in the painting line process is done by applying preventive maintenance scheduling on each component based on hierarchy assessment of system function and malfunction analysis. From the implementation of the scheduling results obtained data as in the tables below.

No	Item	Weekly	Montly
1	Air Blow	x	
2	Under Coat Booth	x	
3	Flash Off	x	
4	Top Coat Booth	x	
5	Setting Room	x	
6	Baking Oven		x
7	Air Supply Unit		x
8	Conveyor		x

Table 1. Planning Preventive Maintenance Schedule Painting Line Component

No.	Item	Before RCM	After RCM	UoM
1	Total up time	12	24	Month
2	Number of Failures	12	1	Failures
3	MTBF	1	24	Month/failures
4	Failure Rate	12	0.5	failures/year
5	Repair Time	7	7	hours/failures
6	Total Repair Time	84	3.5	hours/year
7	Reduce Repair Time		95.83	%

Table 2. Calculation of Mean Time Between Failures (MTBF)

No	Item	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	Air Blow	Rp 4,200,000	p 4,200,00	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000	Rp 4,200,000
2	Under Coat Booth	Rp 5,300,000	p 5,300,00	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000
3	Flash Off	Rp 3,150,000	p 3,150,00	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000	Rp 3,150,000
4	Top Coat Booth	Rp 5,300,000	p 5,300,00	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000	Rp 5,300,000
5	Setting Room	Rp 4,100,000	p 4,100,00	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000	Rp 4,100,000
6	Baking Oven	Rp 4,500,000	p 4,500,00	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000	Rp 4,500,000
7	Air Supply Unit	Rp 4,750,000	p 4,750,00	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000	Rp 4,750,000
8	Conveyor	Rp 4,800,000	p 4,800,00	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000	Rp 4,800,000
9	Total Cost												Rp 433,200,000

Table 3. Repair cost of painting line components before RCM

No	Item	Weekly	Montly
1	Air Blow	Rp 3,500,000	
2	Under Coat Booth	Rp 4,500,000	
3	Flash Off	Rp 2,500,000	
4	Top Coat Booth	Rp 4,500,000	
5	Setting Room	Rp 3,000,000	
6	Baking Oven		Rp 3,500,000
7	Air Supply Unit		Rp 4,000,000
8	Conveyor		Rp 4,000,000
9	Total Cost	Rp	1,074,000,000

Tabel 4. Repair cost of painting line components after RCM

No.	Item	Before RCM	After RCM	UoM
1	Productivity	400	400	Pcs/Hour
2	Defect Ratio	8	2	%
3	Working Process Time	24	24	Hours/day
4	Product Defect	768	192	Pcs/day
5		258,048	64,512	Pcs/year
6	Reduce Defect		75	%
7	AVG Production Cost	84,000	84,000	Rp/Pcs
8	Defect Cost	21,676,032,000	5,419,008,000	Rp/year
6	Defect Cost Savings		16,257,024,000	Rp/year

Table 5. Calculation of defect cost

No.	Item	Before RCM	After RCM	UoM
1	Maintenance Cost	Rp 433,200,000	Rp1,074,000,000	per Year
2	Defect Cost	Rp 21,676,032,000	Rp5,419,008,000	
3	Total Cost	Rp 22,109,232,000	Rp 6,493,008,000	
4	Cost Savings		Rp 15,616,224,000	

Table 6. Calculation of cost savings

Implementation of the RCM begins with the creation of a preventive maintenance schedule for each component in the painting line shown in Table 1. This timetable is determined based on the potential for damage and the effects of damage. From the application of RCM in the company obtained Reliability data are.

A. Probability

Table 2 shows the number of MTBF from 1 month/incidence to 24 months/incidence, this shows the application of RCM with scheduling preventive maintenance can reduce the possibility of unexpected damage.

B. Satisfactory / Expected Performance

The calculations in Table 5 show by reducing the number of possible unexpected damage will lead to the reduction of defective products. Prior to scheduling preventive maintenance of defective products that occurred amounted to 258,048 pieces / year, but after scheduling preventive maintenance defects products only occur as much as 64,512 pieces / year. This RCM program was able to reduce product defects by 75%.

Decreasing the occurrence of defective products will also reduce wasted costs. In Table 3 before the scheduling of preventive maintenance it is seen that every month there has been damage which requires a total cost of Rp 433,200,000 per year, after the scheduling can be seen the maintenance cost incurred of 1.074 million per year as in table 4. If seen this cost value it will be looks much larger after the preventive maintenance scheduling program, but if viewed from the side of defective product reduction up to 75% then it can reduce the cost of defective products of Rp 16,257,024,000 per year as in table calculation 5. If all the costs are compared as in table 6 it will it can be seen that the implementation of preventive maintenance scheduling can reduce the wasted cost by Rp 15,616,224,000 per year.

C. Time

Increasing the value of MTBF can reduce the time to repair 24 times and save the repair time by 95% from the time before scheduling as in the calculation in Table 2. The time saved in the improvement can be used to perform the painting process so as to increase the productivity of painting line.

D. Operating Condition

As stated in points 1 and 2 that by scheduling preventive maintenance in the painting line component can increase the availability of the machine because the value of MTBF is greater and can reduce the defect product that occurs. From both conditions shows that the condition of machine operation is optimal in running the production process.

VII. CONCLUSION

Preparation of preventive maintenance schedule based on RCM assessment on the painting line machine can increase the value of MTBF so as to increase reliability, reduce defective product by 75%, save the cost of Rp 15,616,224,000 per year, reduce the time to repair up to 95% so that machine can operate optimally and help improve company productivity.

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