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IMPLEMENTATION OF TPM (*TOTAL PRODUCTIVE MAINTENANCE) METHOD* ON FILLING LINE 4 MACHINE TO REDUCE REJECTS AND DOWNTIME AT PT.XYZ

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ABSTRACT

PT. XYZ is one of the manufacturing companies engaged in various kinds of cold drinks (beverages), located in Pasuruan regency. In this study, the focus is on the problem of waste defects or product defects in filling line 4 which results in decreased production quality and production targets that cannot be achieved, which results in many losses for the company because of the costs that have been incurred but the results are not according to the target. In the production process on line 4, there are often irregularities in the machine, especially in the filling machine which often experiences troubleshoot, resulting in a lot of waste defects that result in the production target not being achieved. Therefore, analysis and planning for machine repair are needed to reduce or eliminate engine downtime in the filling machine due to the stamp stuck in the line and resulting in product defects or waste defects. In an effort to reduce or eliminate engine downtime and waste defects, using the total productive maintenance (TPM) method, fishbown diagram, and 5W1H method but with certain stages and using lean tools to repair the machine.

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1. Introduction

PT. XYZ is one of companies in the area regency Pasuruan which engages in the field of production drink *(beverage)* which was established in 2012. Various type production the drink including : Original tea , mineral water, coffee and drinks cold other .

The history **PT. XYZ** founded in 1977 with factory First located in Tangerang which produces food namely milk biscuits. With rapid development **PT. XYZ** at the moment That so that has 6 Divisions, each of which produces Different products However integrated covering Several divisions include : Biscuit division, Confectionery division , Wafer division, Chocolate division , Coffee division, Food division health .

Until moment This capacity big production as well as the amount enthusiast to its products , so that Keep going chased by target but with walking time often the machines production experience damage , start from damage light until damage heavy and many losses that occur : downtime, defects product *(waste),* boarding costs (and problems) increases) which results in company and experience loss especially in the part filling machine , causes the occurrence *downtime* and defects product because of a number of matter :

1. Stamp stuck on the stamp line.
2. Dirty stamp path so that the stamp does not walk with fluent .

3. Connection stamp path no resisi .
4. There is a reject stamp.
5. There is n't any yet *OPL (Operational Procedure)* stamp pouring .
6. Product without closed .

So therefore required a methods that can analyze and provide a policies that help company . And also required a innovation and *improvement* on the machines production For help reduce and remove *downtime* , defect product *(waste),* cost care . With known type damage and *downtime* machine can analyzed with method *total productive maintenance (TPM)* is connection cooperation between care and organization production in a way comprehensive aiming For increase quality production , reduce cost during production , increase ability equipment and development from overall maintenance system in the company manufacturing (Check, 2014). In addition writer use method *fishbone diagram* (fishbone diagram) which is one of the method or *tool* inside increase quality production , often this diagram called with cause and effect diagram or 5W1H (K. I. S. Kaoru Ishikawa, January 24, 2016)method . .

Formulation of the problem

Based on background the back that has been outlined above , then obtained formulation problem as following :

1. There is *downtime* machine and defect products that cause results production No achieve the target
2. Types *waste* that appears consequence from the occurrence damage and imperfection conformity filling machine
3. Determination method What only one can used For finish problem existence *reject* and *downtime*
4. Implementation carried out by operators and superior For produce *saving cost* (profit) for company .

Research purposes

As for the desired goal achieved in study This is as following :

1. For know the condition status machine and determine decision action maintenance and repair on the machine *filling* in *Line* 4.
2. Produce proposal action maintenance and repair as well as optimize cost on machine *filling* in *Line* 4.
3. Help company For increase productivity and efficiency production .
4. Help company reach profit For continuation progress company .
5. For add knowledge as well as experience researcher about maintenance and repair filling machine .

Benefits of research

Expected benefits from research conducted is as following :

1. **For researchers**
   Researcher capable apply and compare knowledge gained on the bench lectures to condition existing work , especially with apply TPM (*Total Productive Maintenance)* method , method fishbone *diagram* , method cause and effect For determine action maintenance and repair machine .
2. **For the parties company**
   a. Give information as effort help increase productivity and effectiveness production at PT. XYZ in the future .
   b. Can become consider For take policy For do improvment For help progress company in competition business in the era of globalization .
   c. There is an implementation from A a standardized and systematic approach , where all loss can prevented .
   d. There is an increase pattern predictive behavior and mindset from divisions involved .
   e. Realization activity transparent business going to *zero losses.*
3. **For other parties**
   Can give positive contribution and also can used as reference For study in same field .

Scope of problem

Restrictions problem in study needed so as not to deviate from main the problem that will be researched . Research This restricted in scope :

1. Study conducted at PT. XYZ district Pasuruan only done on the machine *filling line* 4 department production .
2. Discussion regarding damage status machine , maintenance machines , as well as *improvement* machine *filling* in Line 4.
3. Study only on damaged machines consequence the course of the production process **.**
4. *Downtime* data on failures machine and data *waste* (defects) product) month February – May 2019.

2. Review Literature

Study This entitled " *Analysis of Aide Machine Downtime – 150T With Approach Sixbig Losses Using the Seven Tools Method".* In the study This done approach *Sixbig Losses* and analysis use downtime method and *Cause and effect diagram* as well *free diagram* for look for root problems and for help analyze problems that occur in the aide machine – 150T. Results of data processing and analysis carried out is in the form of factors from *downtime* is *over load ,* engine No can go up and down , rough *slide maintenance ,* high production targets , and workmanship products that are not in accordance with capacity machine .(Samanur, K, (2016)

Study This entitled " *The Influence of Preventive Maintenance on results Production In The Production Process Area Line D Machine at PT. Triangle Motorindo " . Preventive maintenance* is one of the type lots of care used by most company manufacturing and services , methods This aiming For prevent damage equipment of a nature suddenly . According to Dhillon (1997) in Antonius Lukmandani et al ., management maintenance can used for to make A policy about activity care , with involving aspect technical and control management to in A program care . While according to opinion Ebelling (1997: 189) in Edi Santoso & Edwin Julianto C, *preventive maintenance* is the care that is done scheduled , generally periodically , where a number of task maintenance like inspection , repair replacement , cleaning , lubrication and adjustment implemented . (Sudrajat, D, 2016)

This *fishbown diagram* (fishbone diagram) is also known as as *Cause and effect diagram* (cause diagram as a result), it is said *fishbown diagram* because its shape resemble framework fish bones and there are also those who say as *Ishikawa diagram* because the first one introduce is Prof. Kaoru Ishikawa from the University of Tokyo (1953). *Fishbown diagram* is a tool or *tools* used For identify dam shows connection between cause and effect in order to be able to find root reason from a problem .

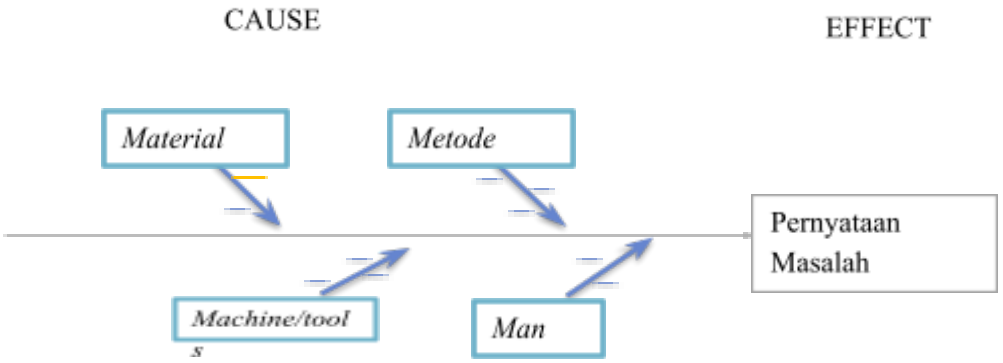


Figure 2.1 . Making *fishbown diagram* – find causes potential (Source :

http://cara.membuat.diagram.fishbown//)

***Method* 5W 1H (Method of Cause) Consequence)**

In the company *manufacturing* especially in the sector production and *quality control* (QC), we often hear existence the term referred to with 5W1H (*Five Ws One H)* . 5W1H basically is a the method used For do investigation and research to the problem that occurred in the production process . 5W1H is abbreviation from 5W , namely , ***What, Where, When, Why, Who*** and 1H , namely ***How* .**

This 5W1H method is also called with *kipling method* , because The term 5W1H was originally taken from Rudyard Kipling's 1902 poem. In its application in the production process , we can use This 5W1H method For gather information and analyze problem happen so that We can take the right solution For overcome it .

Collecting data/ information with use 5W1H method :

a. *What* : problem what happened ?
b. *Where* : where problem That happen ?
c. *When* : when problem That happen ?
d. *Why :* Why problem That Can happen ?
e. *Who* : who only those involved in problem That ?
f. *How* : how method overcome problem That ?

3. Methodology

Framework draft is part research that presents draft theory in form framework draft research . Framework draft This refers to the problems that will be researched / related with research and made in diagram form .

Framework draft is abstraction from a reality in order to be able to communicated and formed a theory that explains relatedness between variable (good) variables studied or not examined). Framework draft will help researcher in connect results discovery .

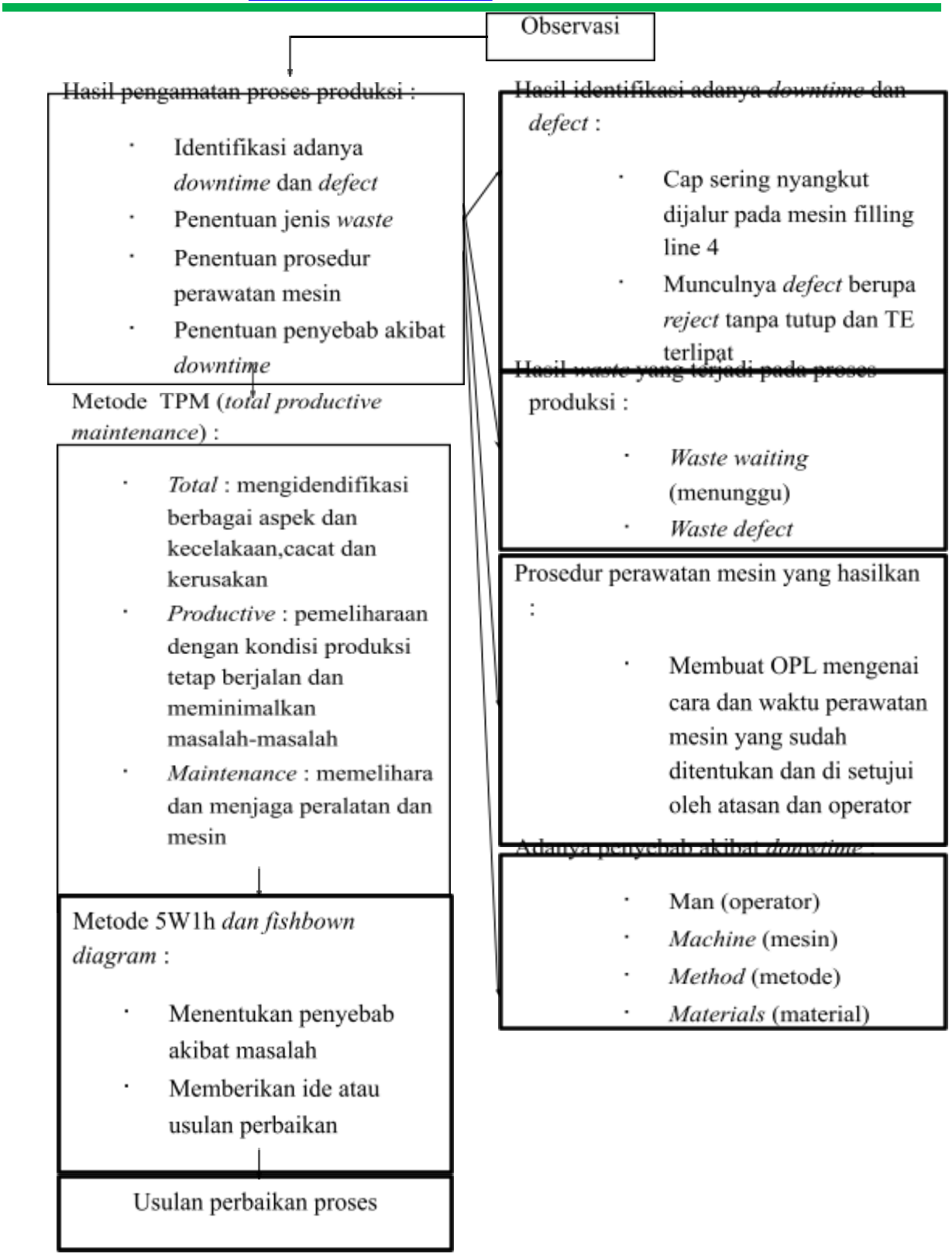


Figure 3.1. framework draft thinking (Source : http://kerangka.konsep.penelitian.com)

Research methods interpreted as a how to do it For get data or information For discuss a problems faced . Research methods have a number of the established stages moreover first . Stages the is research process framework walk systematic , structured , directed and become guidelines researcher For reach the goals that have been set previously . Types of research This is implementation from *seven waste, fishbown diagram, 5W1H method* and TPM (*Total Productive Maintenance).*

Research methods is a procedure or framework used For answer question research that is formulated . The approach used in the research This is quantitative . Research quantitative , namely method research that refers to based on proof empirical with using numerical data and emphasizing the research process on measurement objective results use analysis statistics .

Data source

1. Primary data, namely data obtained directly by researchers .
   a. Interviews , namely data that is direct obtained from interview oral to party companies in the production department , such as filling machine operators and production staff about filling process flow , standard machine and product parameters , result data production , result data *waste defects* that appear .
   b. Observation , namely observation direct For obtain data regarding line production . Required data that is , the flow production , *filling* process flow , *troubleshooting* which often occurs in the filling machine , standard machine parameters and products in the filling machine .
2. Secondary data , namely data obtained in a way No directly by researchers .
   a. Historical data , namely data that is taken the company that will done study that is from history company about line production , production layout position , and its components in the company The data required that is types , functions , and quantities products produced .
   b. Literature review, namely in research conducted by researchers theories taken as benchmark or parameters such as books , journals and so on For become base understanding and parameters of doing research so that when research researcher own reference For do study .

Analysis Techniques

Analysis techniques used in research thesis This is as following :

1. Analyze reason damage machine and defect product use *Total Productive Maintenance* (TPM) based on supporting data that has been obtained .
2. Identifying reason disabled product (*waste*) with use *fishbown diagram* and 5W1H method .
3. Designing and composing recommendation proposal repair as well as machine *improvement* For eliminate and remove *waste.*
4. Compiling and calculating cost expenditure repair with results or profit after done repair machine .
5. Stage giving conclusions and suggestions.

Research Stages /Flow

Flowchart study is a diagram with symbols graphic that shows the process that is displayed symbolized steps in form gambal , along with the order with connecting each step For facilitate the research process that will done .

4. Results and Discussion

Production Results and *Waste Defect* Data per Week

From the data received or obtained by researchers that is from February 26 - May 22 or in week 48 – week 51.

Table 4.1 . Data *Waste Defect* in *Line* 4 On *Week* 48 - *Week* 51

WEEKS	T.CLOSE	DEFORM	WT3	BRIDE BREAK UP	VOLUME LESS	D1 FILLING
48	2821	427	1136	1395	206	201
49	2375	260	227	1498	359	356

50	4387	3202	417	1315	474	308
51	2696	1196	465	1343	466	102

(

D1 SCIENCE	D2	D3	SLIP CLOSE	FOLDED TE	CLOSE THE PERCH	TOTAL REJECT
1131	861	1440	345	1740	72	11775
1294	836	1995	385	1062	113	10760
1141	1089	823	417	1048	131	14752
1918	971	1772	439	1354	263	12985

Source : Data collection , 2020) PT. XYZ

Information :

- Highest *waste* defect is *waste defect* type without close and also *bridge* separated start *week* 48 – 51 caused *stamp* often stuck in the lane *stamp* and also cause the machine stop automatic or happen *downtime.*

The data above show amount *waste defect* in count per pcs is calculated in time per *week* . As for counting in count percent (%) namely with formula :

*** Formula *waste defect* from pcs-% :** *Waste defect* result /Total *waste defect* x 100%

Example : *reject* without close in *week* 48 = 2821/11775x100%=1.938089172=1.9%

Table 4.2 . Production Results and *Achievements* on *Line* 4 in *Week* 48 – *Week* 51

WEEKS	PRODUCTION RESULTS/BOX	PLANT PPIC(PRODUCTION TARGET)/BOX	ACHIEVEMENT (%)
48	169.195	178,750	94.65454545
49	174,720	196,250	89.02929936
50	169,687	190,000	89.30894737
51	174,915	196,250	89.12866242

(Source : Data collection , 2020) PT. XYZ

Information :

- *Plant* PPIC (Production Target)/ *box* = 30,000 *boxes* / day (3 *shifts*) = 10,000 *boxes/shift*

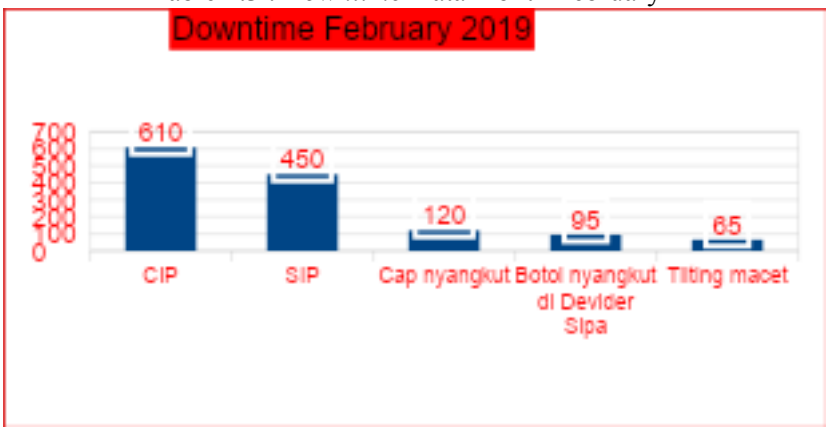
In the target production = 9945 *boxes / shift* = 153 *pallets* (made 9945 because the rest For complete results).

- According to the data above from *week* 48 – 51 *achievement* No achieve the target set by PPIC.

***Report* Data Results : *Downtime* on *Line* 4 in *Week* 48 – *Week* 51**

In accordance *report card* data results existence *downtime* on line 4 is obtained researcher is as following :

Table 4.3 . *Downtime* Data month February



(Source : Data collection , 2020) PT. XYZ

Table 4.4. Total *downtime* on *line* 4 in the month February – May 2019

MONTH	CIP	SIP	STICK CAP	THE BOTTLE WAS STUCK IN THE SIPA DEVIDER
FEBRUARY	610	450	120	95
MARCH	627	450	170	88
APRIL	439	416	93	64
MAY	833	627	101	75
TOTAL DOWNTIME	2509	1943	484	322

TILTING SLOT	PALLET STOCK	TOTAL (MINUTES)
65	-	1340
71	-	1406
75	93	1180
66	-	1702
277	93	5628

Source : Data Collection , 2020) PT

From the data above, the total *downtime* on *line* 4 in the month February – May 2019 , namely CIP (*Cleaning In Place*) 2,509 minutes , SIP (*Sanitation In Place*) 1,943 minutes and *the stamp* stuck on the 484 minute track . So researchers take problem *downtime* caused Because *stamp* Stuck on the track , why? No take problem CIP or SIP *downtime* because CIP or SIP is program or activity company PT. XYZ which must and is required done at the time production .

In the event or program *cleaning* in share into 2 parts time namely , daily and weekly . For daily done *cleaning* routine every *shifts* carried out by all operators. After *cleaning of* machines and areas is carried out must fill in CILA *form that* has been There is with give check (√) what which It is already done whereas For *cleaning* weekly in share into 2 types that is :

a. CIP (*cleaning in place*): cleaning process all part equipment or production pipe without let go or open equipment said . Proes the including *jetting* or *spaying* on *the mixer tank* and circulation on the pipes. CIP is carried out every 72 hours from beginning *start* production every *weeks. In* this CIP process use solution or *chemical caustic* and *acid.*

b. SIP (*sanitation in place*): the sanitation process in tanks and pipelines . This SIP process is carried out after the CIP process with sanitation solution which is used during the CIP process with use *hot water* . The SIP process is carried out 36 hours from beginning *start* production every *weeks.*

With so *downtime* caused *stamp* stuck in the lane There is as source the problem in *line* 4 resulted *achievement and* production targets No what must be achieved quick searching for the cause and immediately completed for production Can walk with smooth and *achievement* and production targets Can achieved .

OEE (*Overall Equipment Effectiveness*) Calculation Data

OEE (*Overall Equipment Effectiveness*) is a measurement effectiveness usage a machine or equipment with count availability engine , performance and quality products produced (&., Misbah, & Amin,, (2016)). The use of OEE as *performance indicator* , taking time base period certain , such as : *shiftly* , daily , weekly , monthly and annual (.,, Rahmad, Pratikto,, & Wahyudi, (2012)). Performance Measurement with OEE (*Overall Equipment Effectiveness*) consists of 3 main components in the production machine, namely Availability (Machine Availability Time), Performance (Number of units produced) and Quality (Quality produced). The result of the OEE calculation is in the form of *a percentage* (%). In Indonesian, *Overall Equipment Effectiveness* is called Overall Equipment Effectiveness.

The OEE (*Overall Equipment Effectiveness*) calculation uses data from " *The Six Big Losses* ", namely:

1. *Availability* , which consists of *Breakdowns* and *Setup/Adjustments*
2. *Performance* , consisting of *Small Stops* and *Slow Running*
3. *Quality* , which consists of *Startup Defects* and *Production Defects*

the overall equipment effectiveness values , there are several data required, including machine operating time, production volume, *ideal cycle time* , and others. These data presented in the table following This :

Table 4.5. Data – OEE Value Calculation Data

No	Month	Operating Hours engine (minutes)	Planned Downtime (minutes)	Downtime (minutes)	Amount Production
1	February	30.160	1.150	1,340	169.195
2	March	32,614	1,077	1,406	174,720
3	April	25,280	855	1.180	169,687
4	May	34,838	1,460	1,702	174,915

(Source : Data Collection , 2020) PT. XYZ

Data processing

The processing that will be carried out to obtain *the Overall Equipment Effectiveness* (OEE) value is by calculating *Availability, Performance* and *Quality* .

Availability

We always expect our Production Machines to be available when we need them. But sometimes the Machines cannot operate according to our expectations in meeting the needs desired by customers. There are two possibilities for the unavailability of Production Machines, including:

a. ***Breakdown***

What is meant by *Breakdown* is a machine failure that is usually more than 10 minutes. *Breakdown time* will be recorded in the form of "Minutes" until the Production Machine can operate again in producing good Product units.

b. ***Setup / Adjustments***

What is meant by *Setup or Adjustment* is the unavailability of Production Machines due to the exchange of models or products. The time calculated is the time from the last unit on the previous model to the first unit on the next model.

Formula *Availability :* $\frac{\text{Total available time} - (\text{Breakdown time} + \text{Setup time})}{\text{Total available time}} \times 100$

Example : *Availability Value* month February = $\frac{30{,}160 - (1{,}340 + 0)}{30.160} \times 100\ \%$

$= \frac{30{,}160 - 1{,}340}{30.160} \times 100\ \%$

$= 95.55\ \%$

Table 4.6 . *Availability* Value Calculation Data

No	Month	Operating Hours engine (minutes)	Setup Time (Adjustment)	Downtime (minutes)	Availability Value x 100 (%)
1	February	30.160	0	1,340	95.5
2	March	32,614	0	1,406	94.3
3	April	25,280	0	1.180	95.3
4	May	34,838	0	1,702	95.1

(Source : Data Collection , 2020) PT. XYZ

Performance

Performance in OEE calculation is the number of product units produced in the available time. This number of units can be either good or defective product units. Those categorized as Performance that will be measured include:

a. ***Small Stop***

What is meant by *Small Stop* is a machine stopping for a short time (usually under 10 minutes) but the frequency of occurrence is high (often occurs). The frequent occurrence of this short stop causes the resulting *output* to decrease. Examples of short stops such as jams or *errors* in production machines. This Small Stop needs to be recorded on *the Tally Sheet so that it is known how often the Small Stop* occurs and the accumulated time.

b. ***Slow Running***

Slow Running is a reduction in the speed of the machine in production, this often occurs when machine maintenance is not carried out properly.

Formula *performance* = Number of units produced x 100 %
Available time x Cycle time
Example : March Performance Value = *174,720* x 100 %
32,164 x 71
= 174,720 x 100 %
2,283,644
= 76.5%

5. Conclusion

Based on research that has been done carried out at PT. XYZ especially on Line 4 that in the month February – May 2019 can concluded that :

1. In the month February – May 2019 recorded existence *minor idling downtime stop* at *line* 4 , namely , CIP (*Cleaning In Place*) 2,509 minutes , SIP (*Sanitation In Place*) 1,943 minutes , stuck *stamp* on track 484 minutes , bottle stuck in the SIPA 322 *divider* , tilting was stuck for 277 minutes and the pallet ran out for 93 minutes .
2. *Troubleshoot* or mismatch in filling machine line 4 in *weeks* 48 – 51 resulted in existence *waste defect* that appears namely , *waste defect* D1 type filling of 967 pcs, slanted lid of 1,586 pcs, folded TE of 5,204 pcs, closed perched 479 pcs, broken *bride* 5,551 pcs and without closed 12,279 pcs. So can taken that *waste defect* type without the most common cause of closure Because *stamp* often often on track *stamp* .
3. Methods used in study This For look for value of *waste defect* and *downtime* data is method **TPM (*Total Productive Maintenance*)** with look for OEE (*Overall Equipment Effectiveness)* value and obtained mark *availability* of 95.05%, the value *performance* of 82.07% and value *Quality* by 92.92% so that obtained OEE value of **76.92%** who are under mark standard international that is **85.40%.** So that need he did search reasons problems and solutions the problem that occurred with use **method *fishbone diagram*** and **5W1H method** .
4. After obtained reasons the occurrence *downtime* filling machine on line 4 so done implementation repair with give *marking* on joints track *cap* , giving OPL to ways – ways pouring *stamp* to in correct *hopper* and adding air plate and hose to the *guider* For entry *stamp* to track *cap* . With thus happen decline *downtime* and *waste defects* in the month **June – August** , so that obtained *cost saving* or profit for company as big as **Rp. 810,831,884/ Year .**

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