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Improving Quality of Production Milk Can Ø 502 X 603 Using the QCC (Quality Control Circle) in Manufacturing Industry

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Abstract:- In the industrial world there will always be competition. Consumer satisfaction is the main factor that can determine the victory in the competition in the industrial world. Consumer satisfaction can be achieved one of them by maintaining the quality of the resulting product. This is the underlying PT. XYZ to continue to improve quality. This research focused on decreasing reject level contained in milk can production process Ø 502 X 603 with Quality Control Circle (QCC) method. The Quality Control Circle (QCC) method is based on a problem solving methodology with PDCA cycle approach, that is: Plan (improvement plan), Do (implement), Check (check), Action (make improvements). which combines the 7 tools method as well as other process improvement approaches. Based on the results obtained oss bubble, voide / empty as the largest number of rejects is as much as 15,200 pcs or 38.59% of the total reject.FromFishboneDiagramanalysisobtainedthecausesofOssbubble,voide/ empty are: unstable OSS viscosity factor, incorrect setting procedure, operator capability is lacking, and engine condition is abnormal. Therefore, it is necessary to make improvements to reduce the number ofrejects.

Keywords:- *QCC (Quality Circle Control), 7 QC Tools, Fishbone Diagram, PDCA (Plan-Do-Check- Action).*

I. INTRODUCTION

1.1 Background

In the industrial world there will always be competition. Competition will continue because every industry player wants their industrial activities to continue and survive. Every industry player will try to win the competition in the industrial world. Consumer satisfaction is the main factor that can determine victory in competition in the industrial world.

But producers are not only faced with the quality that consumers want, they are faced with efficiency and effectiveness. By reducing costs caused by damage or reject of the product. The company will continue to improve its performance so that it can continue to survive and compete with other companies.

At this time in company experienced problems in the production process for Milk Can Ø 502 X 603 which was produced in 2019, the problem that occurred was high product demand with a high level of product defects in the assembly process.

Table 1.1 Production data for January - December 2019

NO	BULAN	QTY	GOOD	JUMALH *REJECT*	% HFI	*PROBLEM REJECT*					
						Oss Bubble, Voide/Empty	*Scratch, Danted*	*Leaking*	*powder Sq in / Bubble*	*Seam Scratch*	*Lain-lain*
1	Januari	887,372	856,372	31,000	3.49%	15,200	2,350	3,500	4,000	5,000	950
2	Februai	770,825	740,345	30,480	3.95%	13,700	3,400	3,680	4,500	4,120	1,080
3	Maret	447,200	435,520	11,680	2.61%	4,250	1,570	1,780	2,200	1,400	480
4	April	678,275	657,495	20,780	3.06%	7,800	4,800	1,250	2,790	2,890	1,250
5	Mei	323,548	313,578	9,970	3.08%	1,950	1,800	2,700	1,360	1,314	846
6	Juni	197,476	190,116	7,360	3.73%	1,720	950	1,200	1,350	890	1,250
7	Juli	765,890	738,020	27,870	3.64%	11,850	2,900	3,850	3,790	4,800	680
8	Agustus	520,784	503,914	16,870	3.24%	8,900	1,950	1,670	1,950	1,425	975
9	September	912,468	887,578	24,890	2.73%	8,850	3,420	2,870	4,600	4,000	1,150
10	Oktober	540,630	512,880	27,750	5.13%	9,800	4,800	5,200	3,400	3,780	770
11	November	287,708	278,168	9,540	3.32%	3,800	1,800	2,500	490	310	640
12	Desember	354,575	338,985	15,590	4.40%	2,400	1,500	6,830	2,900	1,270	690
	Total	6,686,751	6,452,971	233,780	3.50%	90,220	31,240	37,030	33,330	31,199	10,761

Therefore, the analysis step on this problem must be taken in order to get a suitable and appropriate solution.

II. LITERATURE REVIEW

2.1 Concepts andTheories

2.1.1 Definition ofQuality

Definition of quality according to the American Society For Quality cited by Heizer and Render (2006) "Quality is the totality of features and characteristic of a product or service that bears on it's ability to satisfy stated or implied need." This means that quality / quality is the overall features and characteristics of a product or service capable of fulfilling obvious or hidden needs. Menurut Edward W. Deming dalam Nasution (2004).

Quality means a process of continuous improvement starting from a series of cycles from the time an idea to produce a product, product development, production process to distribution to customers is made. Furthermore, it is based on information as feedback collected from product users who develop ideas for creating new products or improving the quality of old products along with existing production processes. From some of the opinion smentioned above, ingeneral, quality is the overall character isticsor characteristics of a productor service that aims to meet the needs and desires of consumers.

2.1.2 Quality Control

Quality control according to Assauri (2008) is an activity (company management) to maintain and directso that the quality of the company's products and services can be maintained asplanned.

According to Gaspersz (2005: 408), quality control is: "Quality control is the operational techniques and activities used to fulfill requirements for quality".

Soitcan be concluded that activity / action carried out to achieve, maintain and improve the quality of a product and service so that it is in accordance with predetermined standards and can meet consumer satisfaction.

2.1.3 Quality Control Purpose

There are at least 4 things that are the goals of quality control, including:

1. Strive for production results to reach predetermined quality standards.
2. Try to keep the damaged products as low as possible, because:

- Can keep inspection costs as low as possible.
- Can try to use raw materials as efficiently as possible.
- Can reduce overall production costs.

3. Determine the corrective actions that need to be taken if a product does not meet predetermined standards.
4. To plan for improving the quality of the products made.

Thus, production control and quality control are closely related to the manufacture of goods. This is because all production activities carried out will be controlled, so that the goods and services produced are in accordance with a predetermined plan, in which the deviations that occur are kept to a minimum.

2.1.4 Quality Control Methods of Quality Control Circle

Quality control must be carried out through a continuous and continuous process. One of the ways to control the quality is through the application of PDCA (plan-do-cheek-action) which was introduced by Dr, W, Edward Deming, a well-known quality expert from the United States. So this cycle is called a deming cycle (Deming Cycle / Deming Wheel). And can improve products in the future. The explanation of the stages of the PDCA cycle is as follows: (Nasution, 2001).

a. Plan (Developing a repair plan) Developing a repair plan is a step after testing the problem repair idea. The repair plan is based on principle5

- W (what, why, who, when and where) and 1 H (how), which are made clearly and in detail and set goals and targets that must be achieved. In setting goals and targets, SMART principles must be considered (Specific, Measurable, Attainable, Reasonable and Time).

b. Do (Implement the plan) The plan that has been prepared is implemented in stages, starting from a small scale and distributing tasks evenly according to capacity and ability of every personnel. During the implementation of the plan, control must be carried out, namely striving for the best implementation of the entire plan so that the goals can be achieved.
c. Check (Checking or examining the results achieved) Checking or researching refers to determining whether the implementation is on track, according to the plan and monitoring the progress of the planned improvements. The tools or tools that can be used to check are Pareto charts, histograms and control charts.
d. Action (Performing the necessary adjustment actions) Adjustments are made if deemed necessary, based on the results of the above analysis. Adjustments relate to standardization of new procedures, in order to avoid recurring the same problem or setting new targets for subsequent improvements. The PDCA cycle rotates continuously, as soon as an improvement is achieved, the state of improvement can provide inspiration for further improvements. Therefore, management must continuously define new goals and targets for improvement.

In the PDCA cycle there is a feedback for checking so as not to lose the direction of the goal of improvement. In this context it is very important to immediately convey product or service improvements to consumers or to the next process for obtaining feedback. Meanwhile, regarding the eight steps of quality improvement, it is a sequential process in which the application uses seven tools consisting of:

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1. Identify problems using stratification, check sheets and histograms.
2. Analyzing the problem can use stratification, Pareto diagram, control chart.
3. Looking for causes can use a fishbone chart diagram.
4. Making a repair plan can use 5 W + 1H
5. Implementim provements.
6. Checking the results of repair can use stratification, histogram.
7. Make standardization Determining the next problem (Nasution, 2001)

2.1.5 Seven Tools

There are several tools that are of ten use dinim proving the condition of a company in order to improve the quality of the products and services it produces. There are several techniques and tools used for numerical data and verbal data. Is the one that is use dis "Seven tools".

III. RESEARCH METHODS

Field Research Data collection is carried out by conducting direct visits to the field, the methods are:

1. Field observation

Knowing the company by seeing how the product defects are in the Milk Can product Ø 502 X 603, knowing the description of the production process of the machine and how the Quality Control team checks the test against the final product of Milk Can Ø 502 X 603.

2. Interview

The author conducts interviews with parties related to the object of the research.

3. Literature review

Literature or literature study is needed to obtain basic knowledge, theories and insights related to the subjects to be revealed in this research. The use of this literature includes books, journals, undergraduate work reports, and internet sites.

The scope of the literature studied is about:

c. Quality Control Circle
d. Seven Tools
e. And related to the literature review

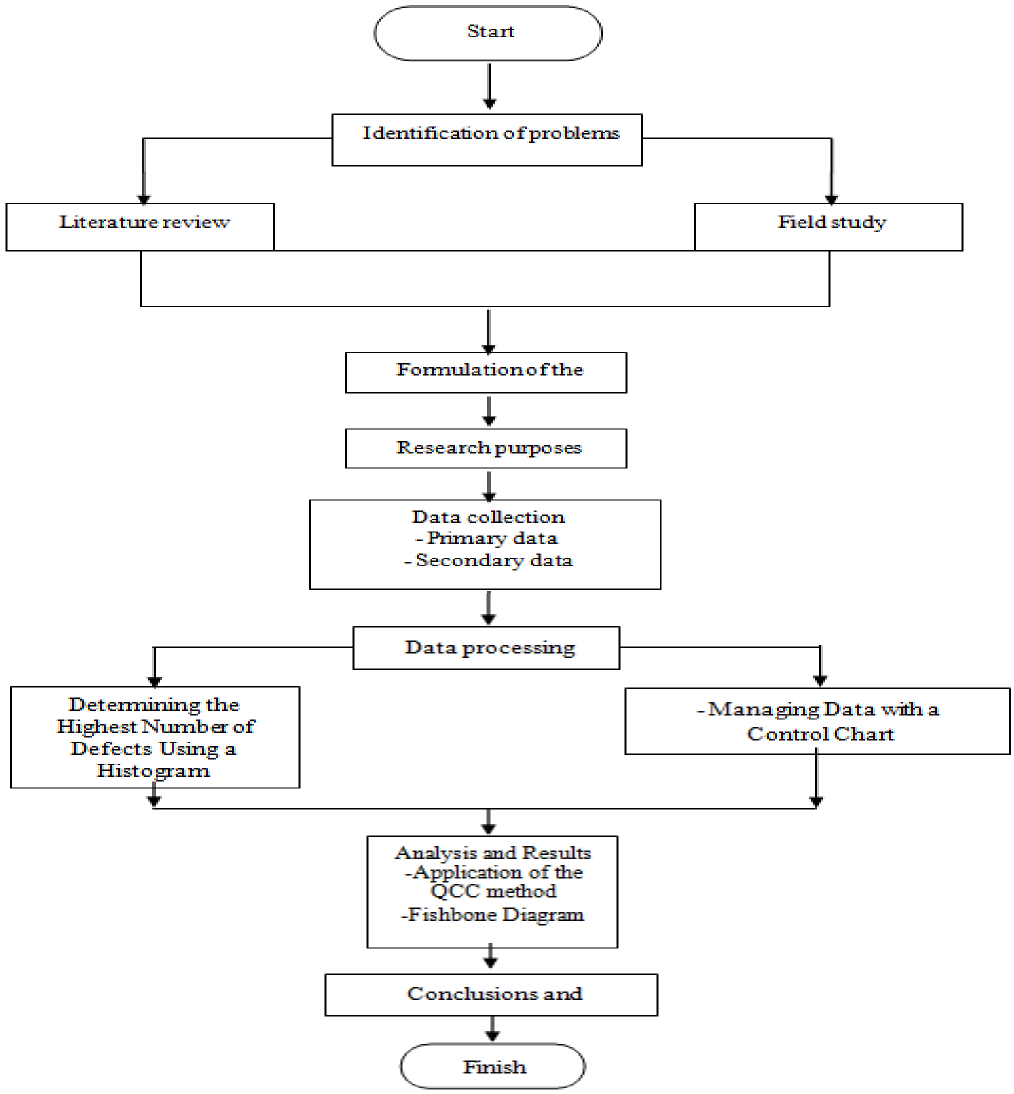

Figure 2.1 Flow chart of research methods

IV. DATA COLLECTION ANDPROCESSING

4.1 Data Collection and Processing

The research was carried out using the steps to solve problems with the Quality Control Circle (QCC) method. This research was prepared based on a problem solving methodology with the PDCA cycle approach that combines the 7 tools method to determine the process that causes defects, collect the necessary data, observe and observe to obtain data. The objectives are taken from the field, analyze the ability of the appropriate process capabilities, look for the causes and effects of the problems that occur and provide suggestions for improvements in the improvement stage that occurs but the percentage is small or rarely occurs.

Table 1.1 Production data for January - December 2019

NO	BULAN	QTY	GOOD	JUMALH REJECT	% HFI	*PROBLEM REJECT*					
						Oss Bubble, Voide/Empty	*Scratch, Danted*	*Leaking*	*powder Sq in / Bubble*	*Seam Scratch*	*Lain-lain*
1	Januari	887,372	856,372	31,000	3.49%	15,200	2,350	3,500	4,000	5,000	950
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12	Desember	354,575	338,985	15,590	4.40%	2,400	1,500	6,830	2,900	1,270	690
	Total	6,686,751	6,452,971	233,780	3.50%	90,220	31,240	37,030	33,330	31,199	10,761

a. Data processing with Histogram

In determining the highest problem reject, it is done using a histogram. The following is the calculation data:

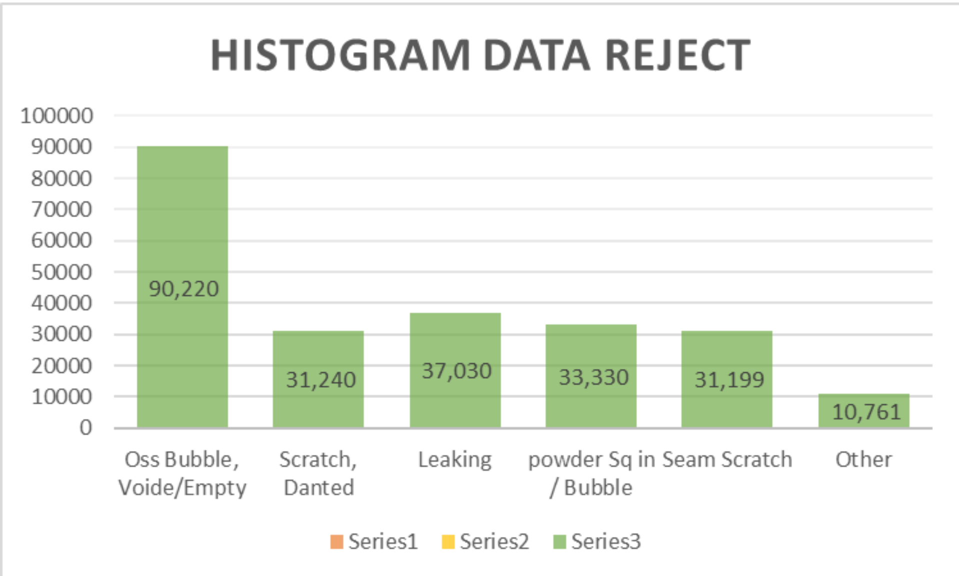

Figure 4.1 Graph of Milk Can product histogram

The histogram image shows that the highest problem rejects for Milk Can products Ø 502 X 603 are the Oss bubble reject type, voide / empty with a total of 90,220 pcs cans, followed by reject leaking with a total of 37,030 cans, reject Powder sq in / bubble with a total of 33,330 tin cans, 31,240 cans of reject scratch and dented products, 31,199 pcs of cans of seam scratch, other reject products such as (dirty, welding problems, trial cans) 10,761 pcs of cans. Therefore, the company will focus on the most dominant damage, namely Powder sq in / bubble, Oss Bubbe, voide / empty, and leaking.

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b. Calculation With Control Chart

To determine the upper control limit (UCL) and the lower control limit (LCL), the average value of the defect is required with the following calculation:

1. Calculating the percentage of damage(P)

$$pc = \frac{x}{xi} = \frac{31.000}{887.372} = 0{,}0349$$

And so on how to calculate up to 12 months

2. Calculate the centerline(CL)centerline which is the average damage to the product (p)

$$CL = GP\ p = \frac{\sum x}{\sum xi} = \frac{233{,}780}{6.686.751} = 0{,}03493$$

And so on how to calculate up to 12 months

3. Calculate the upper control limit(UCL)

$$UCL = P + 3\sqrt{\frac{P\,(1-P\,)}{n}} = 0{,}03493 + 3\sqrt{\frac{0{,}03493\,(1-0{,}03493)}{887.372}} = 0{,}0357$$

And so on how to calculate up to 12 months

4. Calculating the lower control limit(LCL)

$$LCL = P - 3\sqrt{\frac{P\,(1-P\,)}{n}} = 0{,}03493 - 3\sqrt{\frac{0{,}03493\,(1-0{,}03493)}{887.372}} = 0{,}03422$$

And so on how to calculate up to 12 months

NO	BULAN	QTY (Pcs)	GOOD	TOTAL REJECT	%	PC	UCL	CL	LCL
1	Januari	887,372	856,372	31,000	3.49%	0.03493	0.03570	0.03496	0.03422
2	Februai	770,825	740,345	30,480	3.95%	0.03954	0.03570	0.03496	0.03422
3	Maret	447,200	435,520	11,680	2.61%	0.02612	0.03570	0.03496	0.03422
4	April	678,275	657,495	20,780	3.06%	0.03064	0.03570	0.03496	0.03422
5	Mei	323,548	313,578	9,970	3.08%	0.03081	0.03570	0.03496	0.03422
6	Juni	197,476	190,116	7,360	3.73%	0.03727	0.03570	0.03496	0.03422
7	Juli	765,890	738,020	27,870	3.64%	0.03639	0.03570	0.03496	0.03422
8	Agustus	520,784	503,914	16,870	3.24%	0.03239	0.03570	0.03496	0.03422
9	September	912,468	887,578	24,890	2.73%	0.02728	0.03570	0.03496	0.03422
10	Oktober	540,630	512,880	27,750	5.13%	0.05131	0.03570	0.03496	0.03422
11	November	287,708	278,168	9,540	3.32%	0.03316	0.03570	0.03496	0.03422
12	Desember	354,575	338,985	15,590	4.40%	0.04397	0.03570	0.03496	0.03422
	Total	6,686,751	6,452,971	233,780					

Figure 4.2 Calculations using a control chart

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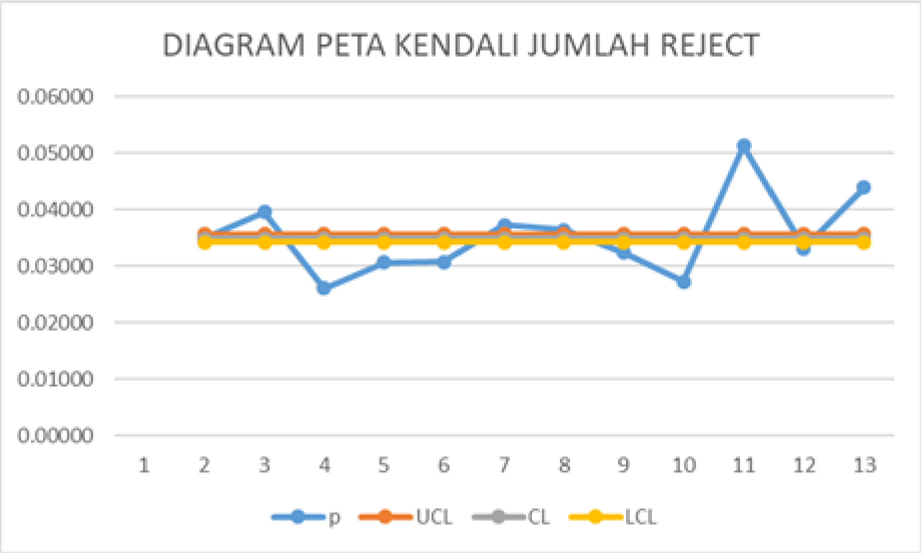

Figure 4.3 Control chart diagram of the reject number

c. Data Adequacy Test

The process capability index is used to determine the level of ongoing capability in the production process. The company determines 3% defects of total production every month. From the production data for January - December is 6,686,751 pcs, then the allowable defects for January - December are 6,686,751 pcs x 3.5% = 234,036.28pcs

After taking the data, the data sufficiency test can be done using the formula:

$N' = \frac{(Z)^2 \times (p) \times (1-p)}{\alpha^2}$

$N' = \frac{(3)^2 \times (0{,}03493) \times (1-0{,}03493)}{0{,}05^2}$

N' = 0,3033 /0,0025

N' =121,355

Because the results obtained N '(121,355) are smaller than N (234,036,28), the data is said to be sufficient to perform control chart calculations.

V. ANALYSIS OF DISCUSSIONRESULTS

a. Disability Analysis Using Pareto Diagrams

In the following, we can see a graph of the three biggest types of defects based on the Pareto that has been made, namely:

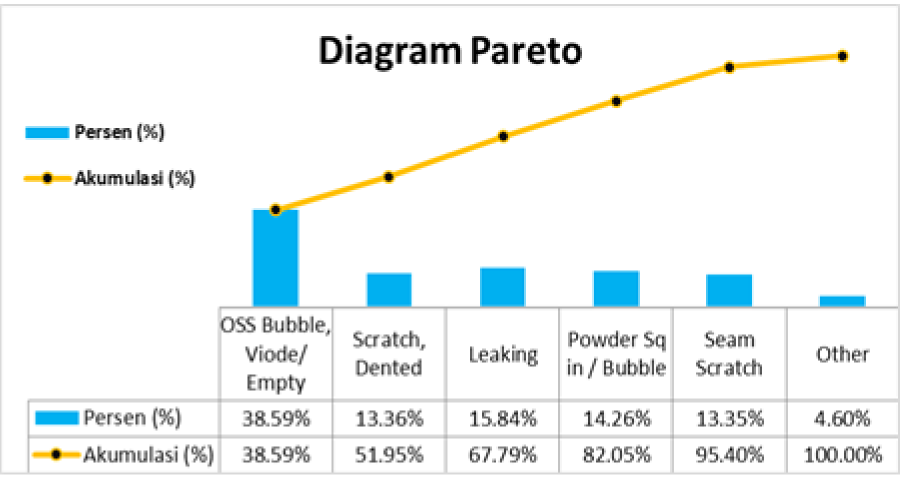

Figure 5.1 Pareto Diagram of Number of Defects

In determining the priority of improvement, it is done using the Pareto diagram. The following is the calculation data:

$$\text{Persentase} = \frac{np \times 100\%}{n}$$

$$= \frac{90.220 \times 100\%}{233.780}$$

$$= 38,59\ \%$$ Etc…..

b. Cause Analysis

After conducting field observations, it is known the factors that affect the occurrence of reject in Milk Can products Ø 502 X 603. After knowing the types of defects that occur, it is necessary to take corrective steps to prevent the emergence of the same defective product. As a tool to find the causes of the defective product, a cause-and-effect diagram is used to trace the most dominant types of defects, which are as follows:

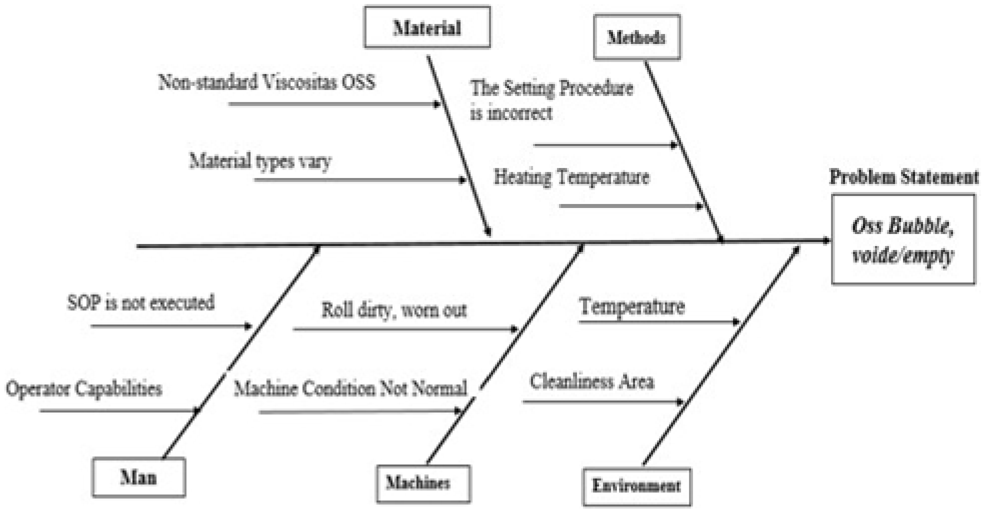

Figure 5.2 Fishbone diagram for OSS Bubble, Viode / empty

c. Application of the QCC Method

Based on the data above, it can be concluded that product defects often occur in the production process of Milk Can Ø 502 X 603, namely Leaking, Oss Bubbe, voide / empty, and powder voide / empty.

A good target must meet the SMART elements (Specific, Measurable, Achieveable, Reasonable, Time Oriented). The following is an explanation of each element in the QCC target:

a) Specific: Removes defects OSS Bubble, Void /Empty
b) Measurable: The highest percentage of defects in OSS Bubble, Void / Empty grew in January 2019, namely 1.71%,decreasing and even disappearing to below 1%.
c) Achieve able: The quality of Milk Can products Ø 502 X 603can be achieved through this QCC.
d) Reasonable: Increase productivity in order to compete in the market.
e) Time Base: In accordance with the time line, several steps must be passed first, namely:

- Analysis of existing conditions.
- Cause analysis.
- Plan of counter measures.
- Implementation of countermeasures.
- Evaluation of results.

Based on the results of the analysis with a cause and effect diagram, which is divided into two types of factors that are directly involved and factors that are not directly involved, here's how the company handles the problem of defect level in the product:

1) Direct factor

a). Machine Factor

- dirty / worn application roll.
- Condition Part / machine parts that support the OSS application process are noting good condition or damaged.

b). Material Factor

- Non-standard OSS material viscosity level.
- The type of OSS to be used for production materials. c). Factor Method
- Improper application roll setting procedure.

2) Indirect factors

a). The Human Factor

- Operator capability. The ability of operators to operate machines and the ability of operators to solve problems that occur during the production process.
- Operators do not run SOPs. Standard Operating Process must always be the operator's reference in

working, so that everything goes as it should.

b). Environment

- Work environment temperature that affects the viscosity of the OSS material.
- Dirty work environment that can affect employee concentration.

d. Countermeasures Plan

QCC's step after searching for the root of the problem that is being experienced is to solve the countermeasures that will be taken to overcome the problem. The countermeasures plan to be carried out is outlined in the following table.

Table 5.1 Handling Table for OSS Bubble, Void / Empty Causes

Item	Existing conditions	Damage effect	Potential causes	Preventive control	Detection control design	Action recommendations	Fulfillment of targets achievement
Material factor	Viscosity of OSS and OSS materials	Causing problems in OSS, such as OSS Bubble, perforated, mixed.	OSS material mixing is still done manually.	Automatically create standard mixing ingredients	Hourly OSS viscosity check by operator.	• Completion of the OSS viscosity check sheet per hour • Making mixing machine automatically	OSS viscosity is stable
Human Factors and Method Factors	OSS application settings are different for each operator	OSS applications are slanted, perforated, bubble, mixed, nonstandard	Lack of knowledge about how to set the appropriate OSS application	Checks applications at the start of the shift and monitors application settings every hour.	*Visually check cans after OSS application*	Standard OSS application setting procedures are made	OSS application settings by default

e. Results Evaluation

During the QCC countermeasures, the defects of Oss Bubble, Voide / Empty are expected to decrease due to repairs, both machines, methods, and man power (operators) who carry out the production process.

f. Standardization

a) Conduct training before operators will be placed in the assembly process, especially new operators.
b) The work process is carried out in accordance with the standards.
c) Operators are required to comply with work process standards.

g. Proposed Improvement

The results of the Fishbone diagram analysis can be seen the factors that cause defects in Milk Can products Ø 502 X 60, as seen from human factors, materials, and methods. For next action is to tackle the problem with priority. So that the steps taken can be effective and appropriate according to the standardization the company wants.

The steps taken to overcome the problem of defects in the product are to use 5W + 1H.

a) What: What caused the problem
b) Why: Why does the problemarise
c) Who: Who solved the problem
d) When: when the cause is overcome
e) Where: The place where
f) How: How to deal with these causes

This method is the steps or actions to minimize the occurrence of deviations. The following is a plan for correcting deviations. What is found in the production process of making Milk Can Ø 502 X 60 can be seen in the table below.

Table 5.2 Proposed Repair Using 5W 1H

No	what	When	Where	Why	Who	How
1	OSS viscosity	during 2019	storage area of the Os and OSS applications on the machine	OSS material mixing is still done manually.	department support	Charging check hourly OSS viscosity sheet Making mixing machine automatically
2	OSS application settings are different for each operator	during 2019	OSS application on bodymaker machines	Lack of knowledge about how to set the appropriate OSS application	Operator	Standard OSS application setting procedures are made

VI. CONCLUSIONS AND SUGGESTIONS

6.1Conclusions

From the results of data processing and analysis that has been done, this study concludes that:

1. By using the seven tools, especially the fishbone diagram, it was finally found that the cause of the defect which affected the number of rejects was the unstable OSS viscosity factor, the different OSS roll settings and the operator's ability to operate the machine.
2. Recommendations for actions that need to be implemented as an improvement effort are as follows:

a) To maintain the stability of the OSS viscosity, in order to make the right Lacquer mixture between the reducer and the lacquer, an OSS mixing machine is made with the appropriate composition.

b) To set up the Oss roll, operators need to do Basic Setting Training, this training is aimed at operators so that they have more skills in setting machines, an SOP is made for setting the Oss roll so that there are no differences in settings between operators, and the importance of communication between operators to prevent previous problems. it happens again.

6.2Suggestions

Based on these conclusions and analyzes, the suggestions that can be given to the company are as follows:

1. It is better if the implementation of using QCC Activities should be carried out continuously so that problems that arise in the production department can be resolved. So that the implementation can be identified more sharply than all the influencing factors can be covered.
2. Conduct regular training for all operators, especially for new operators, thereby reducing the risk of errors in production activities. As well as training operator discipline in implementing and following the Standard Operating Procedure (SOP) when carrying out production activities, as well as increasing supervision in implementing SOPs so that they are in accordance with what has been determined.

Reviewing work methods that make it easier for operators to minimize errors. As well as applying quality improvement methods found in the industrial world. And carry out a continuous and continuous quality improvement process so that customers continue to believe in the products the company produces.

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