ISSN No:-2456-2165

Quality Control Analysis of Candy Wrapping Process Using the QCC (Quality Control Circle) Method in the Candy Industry Indonesian

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Abstract:- PT. XYZ is a company engaged in manufacturing consumer goods namely Candy, etc. in Indonesia. In this case the company wants to increase productivity while maintaining quality in the production process. This is very necessary as one of the company's strategy to survive and have competitiveness with other companies. To maintain consumer confidence in producing quality products, the company has implemented good quality management and complies with applicable quality standard guidelines. In its production activities, the company always tries to produce good products and reduce defects in these products, but in reality in the field many products are found not in accordance with established standards, ie the maximum defect is 0.2% of the total products produced. This study aims to determine how the implementation of quality control using Quality Control Circle (QCC) tools that are useful in efforts to control the level of defects in Candy products in the company. The problem was solved using seven tools and 5 W + 1H. There are 7 types of defects in the candy wrapping process namely folded wrappers, torn wrappers, hole wrappers, no contents, unwrapped wrappers, scratched wrappers, and crushed candy. Types of defects Inner fold up has the largest contribution to the product defects that occur in the candy packaging process that is 0.70%. Some of the factors that cause defects in wrapping are machine, method, environment and human.

Keywords:- *Quality Control Analysis, QCC, Seven Tools, 5W + 1H.*

I. INTRODUCTION

Since PT. XYZ implements efficiency programs in all aspects including man, material, machine, methods and money, and now all divisions at PT. XYZ are competing to produce cost-effective production of the highest quality to compete to meet customer needs, especially at division that makes Candy products that have a large enough market share because Kopiko Candy is a product that is widely consumed by humans both adults and children, currently PT.XYZ has obstacles that must be immediately repaired, these constraints are complaints from customers because there is a wrapper fold defect . This happens because of errors in the aspects of man, material, methods, and environment which cause less optimal / less effective and less efficient machine performance so that the machine cannot produce Candy that is in accordance with the standard product that has been set by the company. This problem occurs in the wrapping machine area.

And from this problem arises a very serious impact for the company that is the loss of customer trust and the company must bear the cost of rework that is forced to do so that customer confidence returns and the customer is satisfied with the product produced.

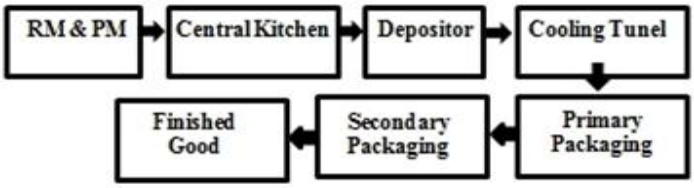

Fig 1:- Flow Process Line Tableting

Production lines are based on the process stages to separate the process phases and in general, the production process flow is as follows:

- **RM & PM area**: this area is a storage area for all raw materials needed to make Candy.
- **Central Kitchen Area**: this area is where the process of mixing and cooking raw materials becomes the initial dough which is commonly referred to by the name "Brix" and then channeled through a pipe to the depositor area.
- **Depositor Area**: this area is where the “Brix” ripening is then added to flavor and then put into the mold.
- **Cooling Tunel Area**: this area is a place for cooling and sorting candy and then channeling it to the wrapping / Primary packaging area.
- **Wrapping / Primary packaging area**: this area is a candy wrapping area with a wrapper that is usually called by the name "INNER". After being wrapped with "Inner" then Candy is distributed to the Secondary packaging area.
- **Secondary packaging area**: this area is a candy wrapping area with a second wrapper which is usually called by the name "CELLO". After being wrapped with "Cello" then Candy is packed into a carton and distributed to the Finished Good area.
- **Finished Good Area**: in this area candy will be rechecked to ensure the quality of candy packaging.

From the Flow Process above the area that is the main focus of improvement is the Wrapping / Primary packaging

area, but this research will focus more on the application of Quality Control Circle (QCC) to reduce the level of Defect, the application of Quality Control Circle (QCC) will also have an impact on engagement operator, focusing on reducing the Defect level, the company must conduct training to improve the operator's capabilities. With the training it is hoped that operators can play a responsive and proactive role in caring for and handling quality problems when production activities are taking place.

Based on the background above, the objectives of this study are: Quality Control Analysis Of Candy Wrapping Process Using The Qcc (Quality Control Circle) Method In The Indonesian Candy Industry

II. LITERATURE REVIEW

According to Juran in Schonberger and Knod (1997), quality is fitness for use. Some tools that can be used for problem solving are statistical process control (SPC). He is oriented to meet customer needs. Juran introduces quality trilogy which consists of:

- *Quality planning*

Quality planningis a process for planning quality according topurpose. In this process the customer is identified and the productwhich is according to customer requirements developed.

- *Quality control Quality control isthe process of achieving goals during operation. Quality controlincludes five stages:*
  - Determine what should be controlled.
  - Determine measurement units.
  - Setting performance standards.
  - Measuring performance.
  - Evaluate by comparing actual performance with performance standards.
- Quality improvement to achieve higher levels of performance.

A. *Quality Dimensions*

While the assessment of good or bad quality of a product can be determined in 8 (eight) quality dimensions introduced by a Quality Control Expert named (David A. Garvin, 1987). The Eight Quality Dimensions raised by David A. Garvin came to be known as 8 Quality Dimensions of Garvin.

The eight quality dimensions are as follows:

1. Performance or Performance is a Quality Dimension related to the main characteristics of a product.
2. Features are the supporting or complementary characteristics of the Main Characteristics of a product.
3. Reliability is the Quality Dimension related to the possibility of a product being able to work satisfactorily at certain times and conditions.
4. Conformance is the suitability of product performance and quality with the desired standard. Basically, every product has a predetermined standard or specification.
5. Durability is related to the durability of a product that must be replaced. Durability is usually measured by the age or time of endurance of a product.
6. Serviceability is the ease of service or repair if needed. This is often associated with after-sales services provided by manufacturers such as the availability of spare parts and ease of repair in case of damage and the existence of a repair service center (Service Center) that is easily reached by consumers.
7. Aesthetics is a quality dimension related to the appearance, sound, taste and smell of a product.
8. Perceived Quality is the Quality Impression of a product felt by consumers.

B. *Quality Control Circle (Qcc)*

Quality Control Circle (QCC) was first introduced by a quality control expert namely Prof. Kaoru Ishikawa in 1962 with the Japanese Union of Scientists and Engineers (JUSE). The first company to run the concept of Quality Control Circle (QCC) was the Nippon Wireless and Telegraph Company in 1962.

According to Dr. K. Ishikawa means Quality Control is an activity of researching, developing, designing and meeting customer satisfaction, providing good service where the implementation involves all activities in the company from the top leadership to the implementing employees.

Quality Control Circle (QCC) is an activity in which a group of employees who work together and conduct regular meetings in seeking quality control (quality) by identifying, analyzing and taking action to resolve problems encountered at work using quality control tools (QC) Tools).

Quality control tools (QC Tools) are usually referred to as QC 7 Tools, which include:

- Pareto Chart
- Fishbone Diagram
- Scatter Diagram
- Control Chart
- Check sheet
- Histogram
- Stratification

C. *Identification*

From the data obtained above the research will be conducted on the wrapping area which is an area that has constraints that must be corrected immediately, this obstacle is a complaint from the customer because there is a defect in the wrapping folds. This happens because of errors in the aspects of humans, materials, methods, and the environment which causes the performance of the machine to be less optimal / less effective and less efficient so that the machine cannot produce Candy in accordance with the standard products set by the company.In this study the problem will be identified and solved by the Quality control circle method.

III. METHODOLOGY

➢ *Data*

The material used in this study is data on the amount of production and data on the number of difect. The data taken is 6 months, namely July 2019 - November 2019.

➢ *Research Methods*

The research method begins with the formulation of the problem, setting goals followed by data collection and processing. End with an analysis and conclusions and suggestions. The data taken is primary data and secondary data. Primary data is data obtained by direct observation in companies, especially interviews with companies. Secondary data is data obtained from company records and reports.

➢ *Data Collection*

In this study the data collected was as follows:
Data on the amount of production and the number of products damaged.

IV. RESULTS AND DISCUSSIONS

A. Data Collection before Improvement

➢ *Research Object Selection*

For this research, the writer focuses more on the Kopiko candy wrappingprocess. Based on the data in table 4.1.the highest defective product seen over a 2 month period is the type of Kopiko Candy with a percentage of defects of 2.09%, the priority of the research object chosen is the Kopiko type product because it has a greater percentage of defects compared to other types of Candy.

Candy Type	Total Production (Kg)	Amount of Defective Products (Kg)	Total percentage of defects
Kopiko Candy 3gr	835,920	17,502	2.09 %
Kopiko Cappucino Candy 3gr	811,730	13,231	1.63 %
Kis Mint Barley Candy 2.5gr	760,230	13,836	1.82 %
Tamarin Candy 2.7 gr	820,350	7,711	0.94 %

Table 1:- Production and disability data in the candy wrapping process July August 2019

➢ *Production defect data*

The following is the production and recording data of Kopiko Candy in the wrappingprocess using data grouping (stratification) according to the time category for the period July 2019 to August 2019 which is presented in table 1 in this study.

Month	Total Production (Kg)	Amount of Defective Products (Kg)	Percentage of Defects
July 2019	423,360	8,467	1.99%
August 2019	412,560	9,035	2.18%
Total	835,920	17,502	4.17%
Average	417,960	8,751	2.08%

Table 2:- Production data and Kopikocandy difectJuly - August 2019

From table 2 the percentage of disability data for 2 months shows that the percentage in July is no more than 2% and this means that the defect of the product is still within tolerance limits. Whereas in August the percentage of 2.18% shows that in that month the percentage of disability exceeds the standard determined by the company.

➢ *Data type is defective*

The following is data on the number of difect that use the data stratification (stratification) technique according to the category of Kopiko Candy record types in the process of wrapping the period from July 2019 to August 2019, which is presented in the table below:

Type of Defects	Number of defects		amount (Kg)
	July 2019 (Kg)	August 2019 (Kg)	
folded wrappers	2,667	3,259	5,926
no contents	1,899	1,822	3,721
torn wrappers	487	575	1,060
unwrapped wrappers	1,630	1,287	2,917
Crushed Candy	874	996	1,870
scratched wrappers	603	760	1,363
hole wrappers	307	336	643
Amount	8,467	9,035	17,502

Table 3:- Data on the type and number of difect of theKopiko Candy in the wrapping process in July - August 2019

➢ *Calculation of percentage of defects*

Based on table 3.the data on the type and number of defects in the packaging process of Kopiko candy for a period of 2 months can be calculated as follows:

Type of Defects	Amount of Defective Products (Kg)	Percentage (%)	Cumulative Amount	Percentage Cumulative
folded wrappers	5,926	33.85 %	5,926	33.85 %
no contents	3,721	21.26 %	9,647	55.11 %
torn wrappers	2,917	16.66 %	12,564	71.77%
unwrapped wrappers	1,870	10.68 %	14,434	82.45%
Crushed Candy	1,363	7.78%	15,797	90.23%
scratched wrappers	1,060	6.05 %	16,857	96.28%
hole wrappers	643	3.72 %	17,500	3.72%
Amount	17,500	100 %		

Table 4:- Percentage of Kopiko Candy difect in July - August 2019

➢ *Making Histograms, Pareto Diagrams, Control Maps*

Based on the data in table 3, a histogram can be made for the following types of defects:

Looks for X max, X min, and range (R) values

X max = 3,259 and X min = 307

Range (R) = X max - X min

= 3,259 - 307 = 2,952

Looking for many classes:

- Number of interval classes (K) = 1 + 3.3 log n
  = 1 + 3.3 (1,146)
  = 1 + 3,781
  = 4,781 = 5
- Length of class interval (P) = R / K
  = 2,952/5
  = 590.4

NO	Class Limits	Middle value	Frequency Signs	Frequency
1	1 – 591	296	IIII	4
2	592 – 1,182	887	IIII	4
3	1,183 – 1,773	1,478	II	2
4	1774 – 2,364	2,069	II	2
5	2,365 – 2,955	2,660	I	1
6	2,956 – 3,546	3,251	I	1
Amount				14

Table 5:- Frequency Distribution Data

Based on table 5 frequency distribution, a histogram of types and Amount of KopikoPermen defects can be made in the wrapper process to find out the lowest and highest frequency, as follows:

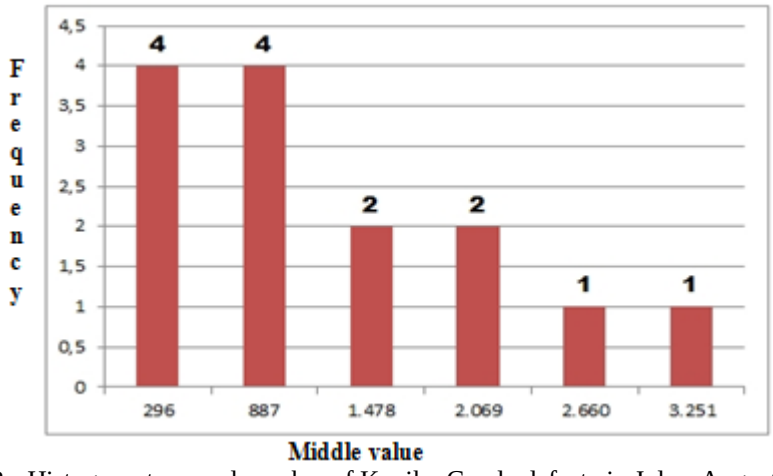

Fig 2:- Histogram type and number of Kopiko Candy defects in July - August 2019

Based on the calculation of the data in table 4, the Pareto Chart can be made as follows:

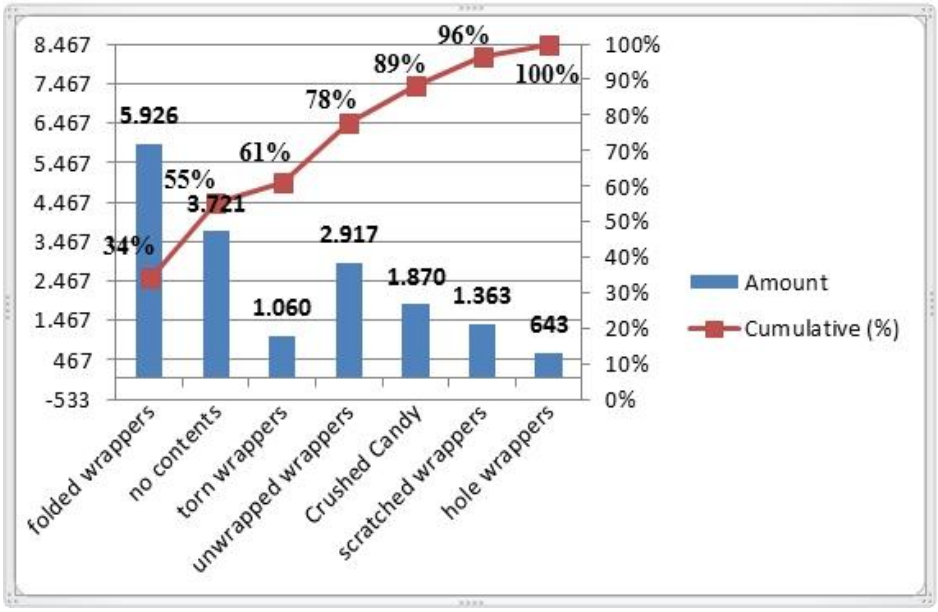

Fig 3:- pareto type and number of defects Kopiko candy in July - August 2019

Calculation of Control Map P, defects in the Kopiko Candy packaging process in July 2019. Random samples were taken 10 times with 100 pieceseach.

Proportion of Samples No.1
P = x / n = 2/100 = 0.02

And by using the same formula a calculation is made for the Proportion of samples No. 2 to No. 10.
ΣPi = 0.22
$\bar{P}i$ = Σ Pi / 10 = 0.22 / 10 = 0.0220

Central = $\bar{P}$ = 0.0220
Standard deviation:

$$\delta = \sqrt{\frac{\bar{P}(1-P)}{n}} = \sqrt{\frac{0.022(1-0.022)}{1000}} = 0.00463$$

$$UCL = \bar{P} + 3\sqrt{\frac{0.022(1-0.022)}{1000}}$$

$$LCL = \bar{P} - 3\sqrt{\frac{0.022(1-0.022)}{1000}}$$

= 0. 0359 = 0.0081

No. Sample	Number of Samples(n)	Number of Pcs defect folded wrappers Products (di)	Propotion Pi=x/n	Standard Deviation	UCL	LCL
1	100	2	0,02	0.00463	0. 0359	0.0081
2	100	1	0.01	0.00463	0. 0359	0.0081
3	100	2	0.02	0.00463	0. 0359	0.0081
4	100	2	0.02	0.00463	0. 0359	0.0081
5	100	3	0.03	0.00463	0. 0359	0.0081
6	100	2	0.02	0.00463	0. 0359	0.0081
7	100	3	0,03	0.00463	0. 0359	0.0081
8	100	2	0.02	0.00463	0. 0359	0.0081
9	100	1	0.01	0.00463	0. 0359	0.0081
10	100	4	0.04	0.00463	0. 0359	0.0081
Amount	1000	22	0.22			

Table 6:- Calculation For control map P, Kopiko Candy defect in July 2019

Based on the data in table 6 and the calculation above, a control map of P, the KopikoPermen defect can be made as below:

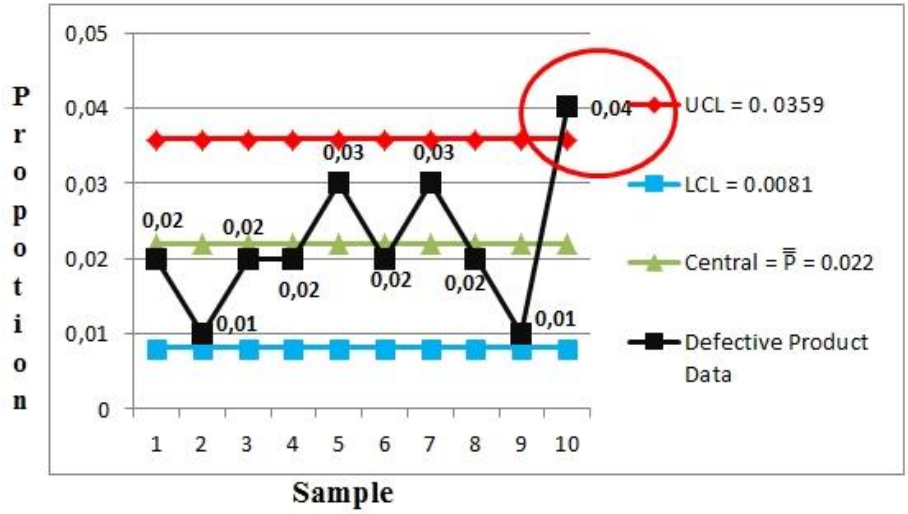

Fig 4:- Control map P, KopikoPermen defect in July 2019

Based on Figure 4 the disability proportion above shows that the sample points number 1, 3, 4, 6, and 8 are on the average line, according to the process criteria said to be controlled. sample points number 2 & 9 are near the *LCL* line and sample points number 5 & 7 are near the *UCL* line according to the process criteria are said to be controlled. for sample no.10 is partly located outside the control limits, it is said to be uncontrollable.

Calculation of Control Map P, Kopiko Candy defect in monthAugust 2019 used the same formula as the previous calculation in July 2019.In the same way the calculation of the KopikoPermen defects in August 2019 can be summarized in the following table 7 :

No. Sample	Number of Samples (n)	Number of Pcs defect folded wrappers Products (di)	Propotion Pi=x/n	Standard Deviation	UCL	LCL
1	100	4	0,04	0.00539	0. 0461	0.0138
2	100	3	0.03	0.00539	0. 0461	0.0138
3	100	3	0.03	0.00539	0. 0461	0.0138
4	100	2	0.02	0.00539	0. 0461	0.0138
5	100	3	0.03	0.00539	0. 0461	0.0138
6	100	4	0.04	0.00539	0. 0461	0.0138
7	100	2	0,02	0.00539	0. 0461	0.0138
8	100	5	0.05	0.00539	0. 0461	0.0138
9	100	2	0.02	0.00539	0. 0461	0.0138
10	100	2	0.02	0.00539	0. 0461	0.0138
Amount	1000	30	0.30			

Table 7:- Calculation For control map P, Kopiko Candy defect in August 2019

Based on the data in table 7 and the calculation above, a control map of P, the KopikoPermen defect can be made as below:

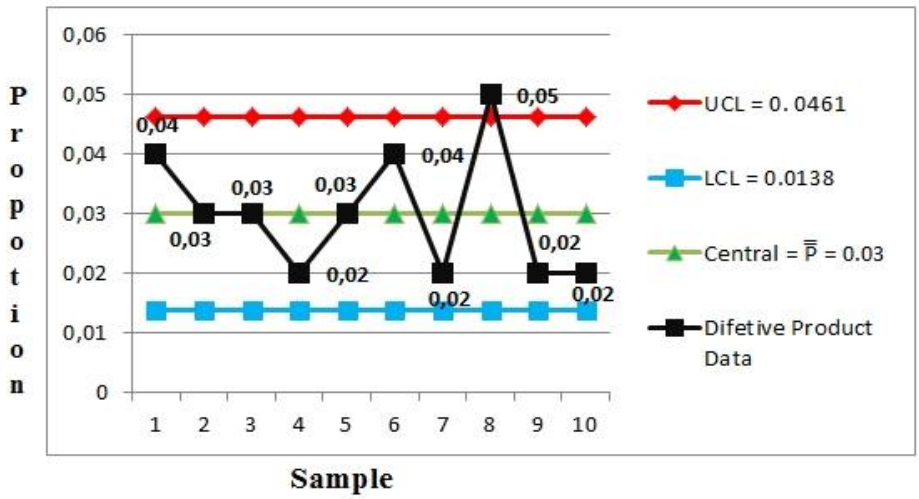

Fig 5:- Control map P, KopikoPermen defect in July 2019

Based on Figure 5 the proportion of defects above shows that sample points number 2, 3, and 5 are on the average line, according to the process criteria are said to be controlled. sample points number 4, 7, 9, & 10 are near the *LCL* line and sample points number 1 & 6 are near the *UCL* line according to the process criteria are said to be controlled. for sample no.8 partly lies outside the control limits, it is said to be uncontrollable.

➢ *Identify Causes of Problems using Fishbone diagrams*

To identify the cause of the defect in the Kopiko candy wrapping process, that is by identifying the root cause of the problem that is carried out by brainstorming with the company as well as a description of the production process so that the source and root causes of the problem are obtained and getting effective and efficient problem solutions. The tool used to identify the root of the problem is fishbone diagrams.

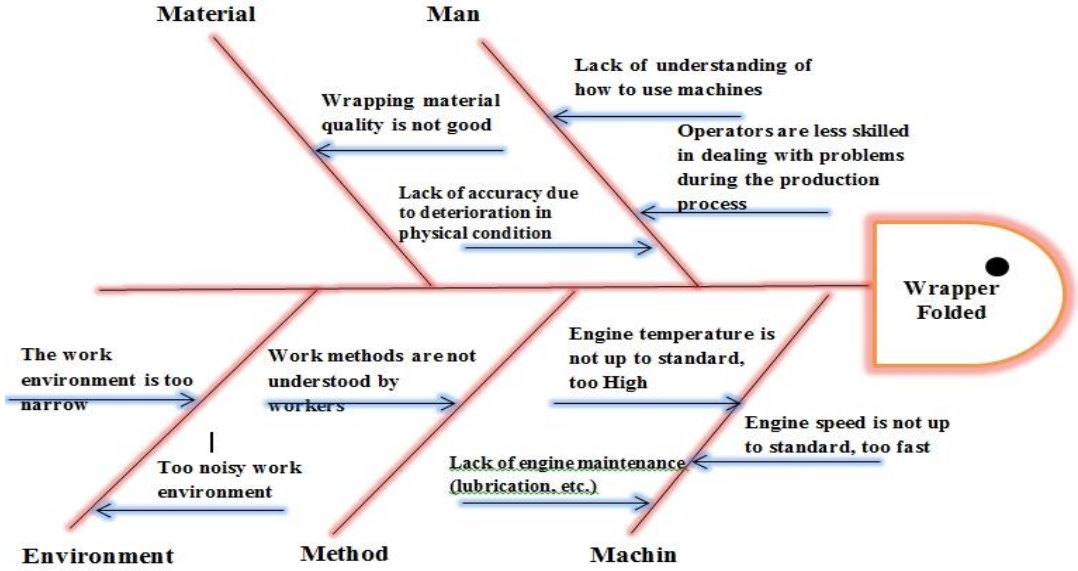

Fig 6:- Fishbone wrapper folded defective diagram

A cause for material factors, namely the wrapper material which is of poor quality, in the human factor, which is lack of thoroughness and fatigue / deterioration in physical conditions, Lack of understanding of how to use the machine operator is less responsive in dealing with problems. the engine factor is the engine temperature does not suit too high / heat, the engine speed is not appropriate / too fast, the lack of engine maintenance (lubrication, etc.).The environmental factor is the work area that is too narrow and too noisy. And the method factor, namely the Standard Operating Procedure (SOP) of the wrap machine is placed in an inappropriate and unclear place so that employees do not understand the Standard Operating Procedure (SOP).

➢ *Improvement Planning*

Kopiko Candy types of candy have one type of disability that is outside the company's standards, namely Wrapper folded by 33.85%. And the process for improvement is done by brainstorming process based on all the characteristics of the defect.

The following is a table of improvement plans (5W + 1H) in the period before repair

NO	What	Why	Where	When	Who	How
1	Man	Lack of understandi-ng of how to use machines	In Area of Candy 4 Wrapping Machine area, Line 4	the biggin-ing of the process of taking the material wrapper, candy wrapping process achine)	Warehouse section workers andall section operators production (Bungku m	Provide guidance on good workprocedures
		Operators are less skilled in dealing with problems during the production process				Add one employee to sort the packaged machine output.
		Lack of accuracy due to deterioration in physical condition				Hold regular health check-ups and pay more attention employee welfare.
2	Material	Wrapping material quality is not good	In the Purchasing and Warehouse Section	When checking the Storage and Distribution of Wrapping Materials	Purchasing, Quality control, and warehouse employees	Material control is more tightened (making a material distribution list with standard material good, not good, bad)
						Quality Control must check the quality of Inner Material before being used by the packing machine operator
						Provide guidance on good work procedures.
						Warehouse employees must get the wapper material for the wrapping machine operator
3	Method	The method is not understood by employees	In the Production Section (Wrapping Machine Operators)	When working on the candy wrapping process	Production Section Employees (Wrapping Machine Operators)	Provide guidance on good work procedures
						Making a standard operating procedure (SOP) that is clear and easy for employees to understand
4	Environ ment	The work environment is too narrow	In Area of Candy 4 Wrapping Machine area, Line 4	During operational working hours	Technician Section and all production department employees (Wrapping Machine Operators)	Calculate the right time for line rearrangement
						Rearranging the 04 line production line Wrapping Machine to make it more presentable
		Too noisy work environment				Operators are required to wear safety devices in the form of ear plugs
5	Machine	Engine temperature is not up to standard, too high / hot	Di Bagian Mesin Bungkus Candy 4, Line 4	Di awal proses pengambilan material Inner, proses pembungkusana n permen	Bag.Teknisi danseluruh karyawan bag. produksi (Operator Mesin Bungkus)	Provide guidance on good work procedures
		Engine speed is not up to standard, too fast				Making a standard operating procedure (SOP) that is clear and easy for employees to understand
						Quality Control must check speed and temperature every 2hours
		Lack of engine maintenance (lubrication, etc.)				Perform maintenance regularly min once a week periodically replacement of engine spare parts

Table 8:- Improvement plans (5 W + 1 H)

B. Data Collection After Improvement

➢ *Product data is defective*

Month	Total Production (Kg)	Amount of Defective Products (Kg)	Percentage of Defects
October 2019	430,340	7,260	1.68%
November 2019	401,640	6,876	1.71%
Total	831,980	14,626	3.51%
Average	415,990	7,313	1.75%

Table 9:- Production data and Kopikocandy difect October-November2019

Based on table 8 the percentage of defective data for 2 monthsshows that the percentage in October and November is no more than 2% and this means that the defect of the product is still within the tolerance limits set by the company.

➢ *Data Type of Difective*

Type of Defects	Number of defects		amount (Kg)
	October 2019 (Kg)	November 2019 (Kg)	
folded wrappers	1,955	2,070	4,025
no contents	1,710	1,570	3,280
torn wrappers	567	468	1,035
unwrapped wrappers	1,410	955	2,365
Crushed Candy	743	677	1,420
scratched wrappers	527	720	1,247
hole wrappers	348	416	764
Amount	7,260	6,876	14,136

Table 10:- Data on the type and number of difect of the Kopiko Candy in the wrapping process in October-November2019

From the table 4.10 above, the largest defect type obtained during October 2019 - November 2019 is the type of wrapper fold with a defect number of 4.025 kg which is most dominant but when compared with the number of wrapper defect folds during July 2019 - August 2019 amounting to 14 units there was a decrease of 5.20%.

➢ *Calculation of percentage of defects*

Based on table 10 the data on the type and number of defects in the wrapping process of Kopiko candy for a period of 2 months can be calculated as follows:

Type of Defects	Amount of Defective Products (Kg)	Percentage (%)	Cumulative Amount	Percentage Cumulative
folded wrappers	4,025	28.66%	4,025	28.66 %
no contents	3,280	23.36%	7,305	52.02 %
torn wrappers	1,035	7.37%	8,340	59.39%
unwrapped wrappers	2,365	16.84%	10,705	76.23%
Crushed Candy	1,420	10.11%	12,125	86.34%
scratched wrappers	1,247	8.88%	13,372	95.22%
hole wrappers	764	4.78%	14,136	100%
Amount	14,042	100 %		

Table 11:- Percentage of Kopiko Candy difectin October-November2019

➢ *Making Histograms, Pareto Diagrams, Control Maps*

Based on the data in table 3, a histogram can be made for the following types of defects:

Looks for X max, X min, and range (R) values

X max =2,070 and X min = 384

Range (R) = X max - X min

= 2,070 - 384 = 1,722

Looking for many classes :

- Number of interval classes (K) = 1 + 3.3 log n
  = 1 + 3.3 (1,146)
  = 1 + 3,781
  = 4,781 = 5
- Length of class interval (P) = R / K
  =1,722/5
  = 344.4

NO	Class Limits	Middle value	Frequency Signs	Frequency
1	1 – 344	172	0	0
2	345 – 689	516	\ IIII I	6
3	690 – 1,034	860	III	3
4	1,035 – 1,379	1,207	0	0
5	1,380 – 1,724	1,552	III	3
6	1,725 – 2,070	1,898	II	2
Amount				14

Table 12:- Frequency Distribution Data

Based on table 5 frequency distribution, a histogram of types and Amount of KopikoPermen defects can be made in the wrapper process to find out the lowest and highest frequency, as follows:

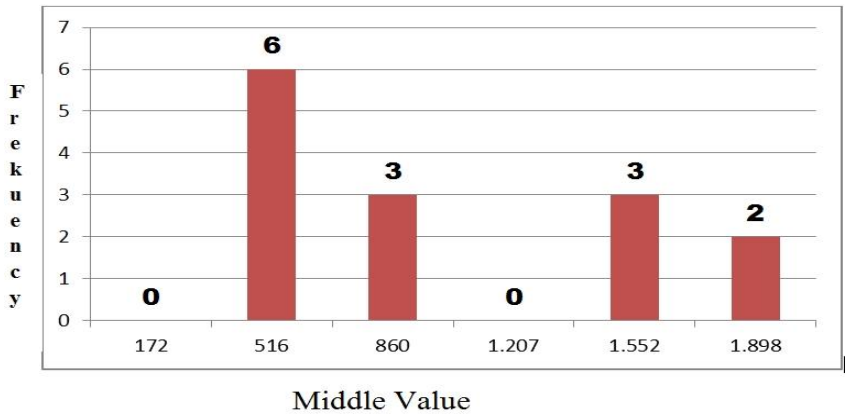

Fig 7:- Histogram type and number of Kopiko Candy defects in October-November2019

Based on the calculation of the data in table 11, the Pareto Chart can be made as follows:

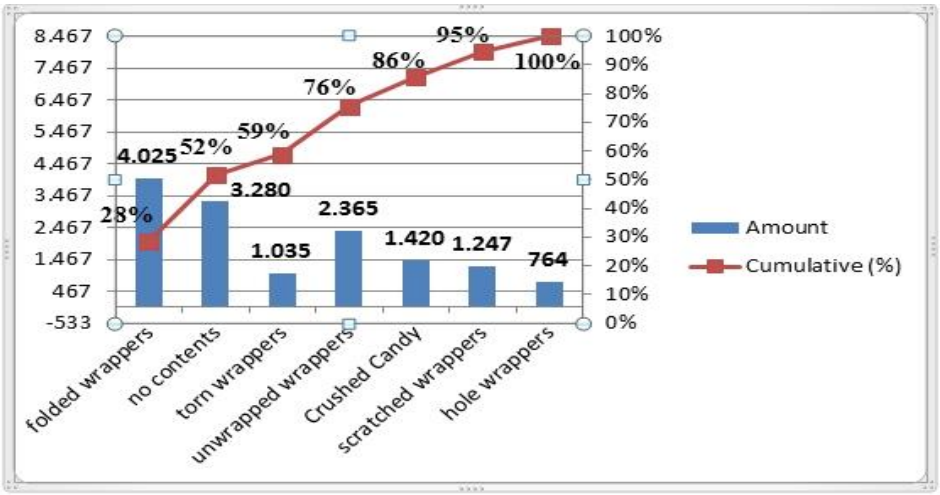

Fig 8:- pareto type and number of defects Kopiko candy in October-November2019

Calculation of Control Map P, defects in the Kopiko Candy packaging process in October 2019. Random samples were taken 10 times with 100 pieceseach.

Proportion of Samples No.1
P = x / n = 2/100 = 0.02

And by using the same formula a calculation is made for the Proportion of samples No. 2 to No. 10.

$\Sigma Pi = 0.14$

$\bar{P}i = \frac{\Sigma Pi}{10} = \frac{0.14}{10} = 0.014$

Central = $\bar{P}$= 0.014

Standard deviation:

$$\delta = \sqrt{\frac{\bar{P}(1-P)}{n}} = \sqrt{\frac{0.014(1-0.014)}{1000}} = 0.00371$$

$$\text{-UCL} = \bar{P} + 3\sqrt{\frac{0.014(1-0.014)}{1000}} = 0.0251$$

$$\text{-LCL} = \bar{P} - 3\sqrt{\frac{0.01(1-0.01)}{1000}} = 0.00287$$

No. Sample	Number of Samples (n)	Number of Pcs defect folded wrappers Products (di)	Propotion Pi=x/n	Standard Deviation	UCL	LCL
1	100	1	0,01	0.00371	0.0251	0.00287
2	100	1	0.01	0.00371	0.0251	0.00287
3	100	2	0.02	0.00371	0.0251	0.00287
4	100	1	0.01	0.00371	0.0251	0.00287
5	100	2	0.02	0.00371	0.0251	0.00287
6	100	2	0.02	0.00371	0.0251	0.00287
7	100	1	0,01	0.00371	0.0251	0.00287
8	100	1	0.01	0.00371	0.0251	0.00287
9	100	2	0.02	0.00371	0.0251	0.00287
10	100	1	0.01	0.00371	0.0251	0.00287
Amount	1000	14	0.14			

Table 13:- Calculation for control map P, Kopiko Candy defect in October 2019

Based on the data in table 6 and the calculation above, a control map of P, the KopikoPermen defect can be made as below:

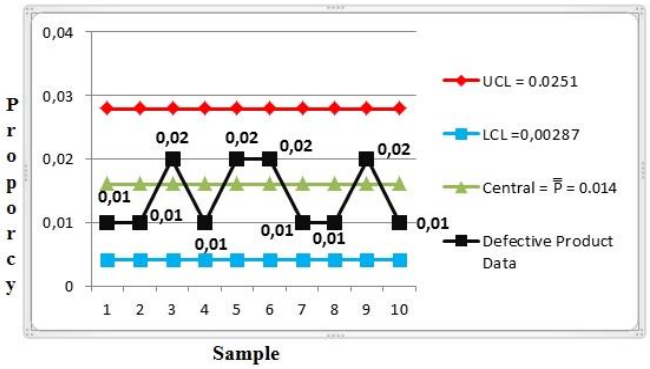

Fig 9:- Control map P, KopikoPermen defect in October 2019

Based on Figure 9 the proportion of defects above shows that the point is located near the average line according to the criteria of a process said to be controlled even though there are several points located close to the UCL and LCL lines.

Calculation of Control Map P, Kopiko Candy defect in monthNovember 2019 used the same formula as the previous calculation in October 2019.In the same way the calculation of the KopikoPermen defects in November 2019 can be summarized in the following table 14:

No. Sample	Number of Samples (n)	Number of Pcs defect folded wrappers Products (di)	Propotion Pi=x/n	Standard Deviation	UCL	LCL
1	100	2	0,02	0.00408	0.0292	0.00476
2	100	1	0.01	0.00408	0.0292	0.00476
3	100	1	0.01	0.00408	0.0292	0.00476
4	100	2	0.01	0.00408	0.0292	0.00476
5	100	2	0.02	0.00408	0.0292	0.00476
6	100	2	0.02	0.00408	0.0292	0.00476
7	100	2	0,01	0.00408	0.0292	0.00476
8	100	1	0.01	0.00408	0.0292	0.00476
9	100	2	0.02	0.00408	0.0292	0.00476
10	100	2	0.01	0.00408	0.0292	0.00476
Amount	1000	17	0.17			

Table 14:- Calculation For control map P, Kopiko Candy defect in November2019

Based on the data in table 14 and the calculation above, a control map of P, the KopikoPermen defect can be made as below:

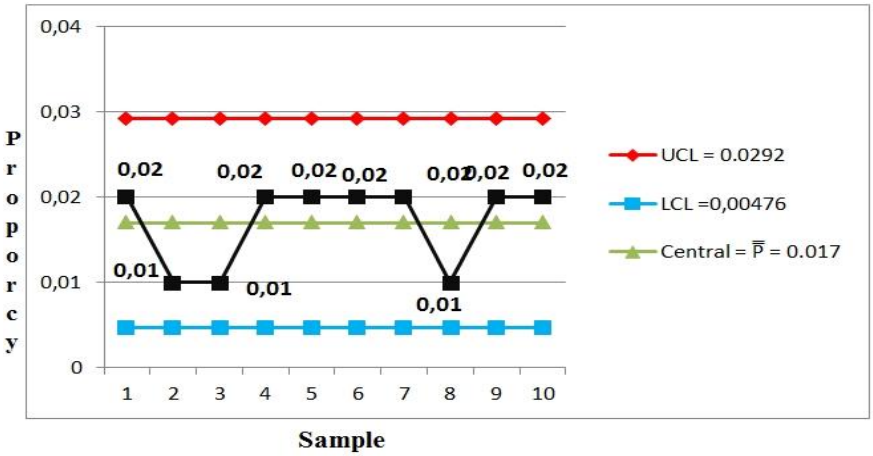

Fig 10:- Control map P, KopikoPermen defect in July 2019

Based on Figure 10 the proportion of defects above shows that the point is located close to the average line according to the criteria of a process said to be controlled even though there are several points located close to the LCL line.

C. Data Comparison Results Percentage of defects before repair with after Repair

Defect Type	Defect (%)		Change (%)	Information
	Before Repair	After Repair		
	A	B	C	
folded wrappers	0.70	0.48	- 0.22	Defect Down
no contents	0.44	0.39	- 0.05	Defect Down
torn wrappers	0.16	0.17	0.1	Defect Up
unwrapped wrappers	0.12	0.14	0.2	Defect Up
Crushed Candy	0.35	0.12	- 0.23	Defect Down
scratched wrappers	0.22	0.28	0.6	Defect Up
hole wrappers	0.08	0.09	0.1	Defect Up

Table 15:- Comparison of defects in the packaging process of Kopiko candy before and after the proposed improvement

The percentage that increased between the period before the period after the repair occurred because of the lack of optimal improvement in reducing the level of product defects that exist in the machine, material and human / operator. This shows the results can be said to be good, because of the 7 types of defects there are 3 types that have decreased the level of defects.

D. Make Standardization

This step is used to ensure that quality improvement can run according to the expected target. In this step the standardization created can control the process examined in Kopiko candy wrapping and the defects that occur are not repeated. The results of the proposed improvements in table 16 below, show the achievements achieved after the implementation is carried out which can be seen in the calculation of the following percentage of defects:

- Period Before Repair: Percentage of defect = $Defects\ Amount\ /\ roduction\ Amount$ x 100%
  = 17,500 / 835,920 x 100%
  = 2.09%
- Period After Repair: Percentage of defect = $Defects\ Amount\ /\ roduction\ Amount$ x 100%
  = 14,042 / 831,980 x 100%
  = 1.69%
- Defect Difference: 2.09% - 1.69% = 0.4%

Periode	Juli 2019 – Agustus 2019	Oktober 2019 – November 2019	Selisih Cacat
Jumlah Produksi (Kg)	835,920	831,980	-
Jumlah Cacat (Kg)	17,500	14,042	-
Prosentase Kecacatan	2.09%	1.69%	0.4%

Table 16:- Calculation of Comparison of Percentage of Production Defects in the Kopiko Candy Wrapping Process Before and After Proposed Improvements

The results in table 16 above show a decrease in the percentage of production defects that exist in the company, although not too large, but it can minimize production defects in the candy packaging process.

Make the achievement of this improvement a minimum standard that must be maintained. And for the future the percentage of disability is standard, which must be no more than 2.0% with a benchmark of the percentage of defects in this study**.**

V. CONCLUSIONS

This research was conducted in the candy industry with the aim to improve the quality of production results and reduce losses that cause a high level of disability, namely by increasing the operator's ability to perform maintenance, handle engine problems by implementing Autonomous Maintenance by returning the best machine performance, standardizing important parts on the wrapping machine, check periodically and conduct training and share with the operator about the wrapping machine components and critical parameters and make some related improvements that can improve the performance of the machine. put special staff in the quality control section to control and tighten the selection of raw materials.

Various problems on the wrapping machine have been identified by the Quality Control Circle method and the problem has been resolved. Solving these problems will greatly help improve the productivity and efficiency of a production process and the losses incurred by the machine because the high level of disability will also be directly proportional to the application of maintenance in the manufacturing industry which greatly affects the mindset of workers, especially production operators, previously operators could only operate machine when a problem occurs. It all depends on the technician and the implementation of autonomous changes from all these things so that the operator can take care of the machine and can also handle problems if there are problems with the machine.

REFERENCES

[1]. Cavanagh, Peter S. Pande, Robert P.Neuman. 2002.The Six Sigma Way",PenerbitAndi, Yogyakarta.
[2]. Crocker, Olga L. 2004.GugusKendaliMutu (Pedoman, PartisipasidanProduktivitas),BumiAksara, Jakarta.
[3]. Deny Kristiawan; NIM : 1.03.00.067, Pencapaiankualitas, Team QCC, SiklusPDCA, TujuhAlat Bantu. JurusanTeknikIndustri, FakultasTeknikdanIlmuKomputer, UNIKOM.2004-10-07.
[4]. Fajar, PrimadiAchmad ; NIM : 1.03.00.103, Pencapaiankualitas, Team QCC,Siklus PDCA, TujuhAlat Bantu. JurusanTeknikIndustri, FakultasTeknikdanIlmuKomputer, UNIKOM.2005-09-05.
[5]. Gaspersz,V. 2002. Vincent, PedomanImplementasi Six Sigma, GramediaPustakaUtama,Jakarta.
[6]. Montgomery, Douglas C.1995.PengendalianKualitasStatistik, Yogyakarta :Gajah Mada University Press.
[7]. Nasution, M. 2002.ManajemenMutuTerpadu (Total Quality Management)",PenerbitAndi, Yogyakarta.
[8]. Soejanto, Irwan. 2007.RekayasaKualitas "EksperimendenganTeknik Taguchi",YayasanHumaniora, Surabaya.
[9]. Sudjana. 2002.MetodeStatistika, Tarsito, Bandung.
[10]. Tjiptono, F., dan A. Diana.2001.Total Quality Management, EdisiRevisi,Yogyakarta : Andi Yogyakarta
[11]. Wignjoesoebroto, Sritomo. 2003.PengantarTaknikdanmanajemenIndustri,GunaWidya, Jakarta.
[12]. Kholil, M., &Dwi, P. 2017. TinjauanKualitasPada Aerosol Can Ø 65 X 124 DenganPendekatanMetode Six Sigma Pada Line Abm 3 Departemen Assembly. JurnalSinergi, Volume. (21)1, 53-58.
[13]. Kholil, M. 2014. Implementasi Lean Six Sigma DalamPeningkatanKualitasDenganMengurangiProduk Cacat NG Drop Di Mesin Final Test Produk Hl 4.8 Di PT. SSI. Jurnal PASTI, Volume. 8(1), 14 – 29.
[14]. Rimawan, E., Agung, H. 2017. Welding Process Improvement in Pressure Vessel Fabrication Approach to DMAIC Methodology case in Small and Medium Industries in Indonesia. International Journal of Scientific & Engineering Research, Volume. 8(1), 77-81.
[15]. Rimawan, E. 2010. Six Sigma UntukPengendalianKualitas Cooling Performance Refrigerator Di PT. Lg Electronics Indonesia. Jakarta: UniversitasMercu Buana.