Quality Improvement Analysis With Plan-Do-Check-Action (PDCA)

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Abstract

Research Object is the Company manufacturers producing drinks, one product is TBS drinks in bottles. The Company continues to develop methods for quality improvement. Efforts to improve the quality of products is done by analyzing the application of quality control in the production of beverage bottling processes TBS and look for factors that cause damage to the product on the production floor. The method used in this research is the PDCA cycle. The tools used to analyze this research is the check sheet, stratification, Pareto charts, pie charts, cause-effect diagram, 5W1H, a bar chart. Is expected to bring the company to be at the level of the lowest defective products, especially in the bottling process. The study found that the standard type of product does not occur during the months of August to December 2016 in the process of bottling line TBS is bottled chipped / cracked that reached 697 crates. Found 3 factors were dominant cause of nonstandard products bottle chipped / cracked is not appropriate stopper position, the flow path is too deep chute crown, and crown dented / damaged reached 1,362 crates in April 2017. After the refurbishment in May 2017, successfully reduced by 169 from 1,362 down 1,193 crates or crates. And again decreased in the establishment of standardization at 69 of 169 crates or a decrease of 100 crates

Keywords
Quality, Cycle PDCA, Quality improvement Tools.

1. Introduction

The company that makes quality as a strategy will have a competitive advantage against its competitors in the market master, because not all companies are able to achieve the best quality. In this case the company is required to produce products with high quality and affordable price (Fakhri and Kamal, 2010). Business performance improvement must cover the entire industrial system. One part of the industrial system should undergo continuous improvement is the process of production (Sobek II and Smalley, 2011). because the production process is not possible apart from product defects even possible production failure that resulted in a waste of the process (Widiaswanti, 2017). Efforts to control the quality of the PDCA cycle 8-step troubleshooter quality improvement (Moen and Norman, 2006).

The company is a manufacturer producing drinks, where one product is TBS produced in bottles. Until now company, continue to develop methods in improvement of product quality (Parassari, 2017). In achieving maximum

results, TBS product through several stages of the production process with each of the standard specifications set by the company. Among the water treatment must be done properly and regularly, the cooking process include the selection of the best tea, use sugar with high quality, mixing corresponding materials, tea temperature cooking and packaging process. Bottling process includes a bottle of good quality and clean, as well as charging Sweet Tea Liquid according to established standards. At the time of the production process, especially in the bottling process is still a lot of damage or discrepancies (Sani, 2015) . No standard or defective product is a product that is not in accordance with product qualification. Qualification of defective products in the process of bottling the company is broken bottle, the bottle chipped / cracked and volume are not standard TCM in the bottle. Based on data of companies per 2016 in the bottling process is still obtained product that does not comply with the standards. In a production process, the number of products not according to standards must be minimized. That is because either directly or indirectly, the number of standard products are not going to cause harm to the company (Kaban, 2014).

By using the concept of PDCA cycle quality control 8-step troubleshooter quality improvement (Escalante, 1999), is expected to bring the company to be at the level of the lowest defective product or a zero defect in the bottling process and determine the factors causing the occurrence of product defects in the bottling TBS process.

2. Methods

We conducted the identification of problems that occur in the company on quality control in bottles that are then used as the basis for the formulation of the problem. In this case, a problem that has been identified in the form of a high number of defects in the production process is the process of bottling the product TBS in the company. Then the data collection was conducted in August until the month of December 2016 in which the data collected in the form of primary data and secondary data obtained directly from the company by means of: the method of observation (observation), interview and documentation.

In the next stage is the processing and analysis of data. Measures conducted by researchers for data processing is:

1. Cycle PDCA-8 Step Troubleshooter. In conducting the gathered data processing, then use tools PDCA cycle (Moen and Norman, 2006). The steps are as follows:
    a) Define the problem (determine the theme of problems) by using a check sheet, stratification, Pareto diagrams, pie charts.
    b) Finding all possible causes by using a causal diagram, the dominant cause analysis.
    c) Determine the main causes by using the check sheet to test the cause, the cause stratification test, Pareto diagrams, pie charts.
    d) Draw up a plan to use 5W-1H, specify a target, a bar chart.
    e) Implement corrective measures by creating a table plan improvements and implementation of improvements.
    f) Evaluating results against plans by using the check sheet and stratification evaluation of results, Pareto diagrams, tables comparison before and after mitigation.
    g) Standardizationm improvements using standardized manufacture table, check sheet, and Stratification evaluation results after the repair, the comparison table before and after standardization
    h) Noting unresolved issues.

3. Results and Discussion

The data obtained in the form of daily report data FFB production during the month of August to December 2016. In Table 1 and 2 data on the number of production and nonstandard products during August to December of 2016 as shown on table 1 and table 2.

Table 1. Data of total production (in crates)

August	September	October	November	December
223.493	190.349	186.780	180.585	238.388

Table 2. Data of not standard bottles (in crates)

No.	Month	Product No Standard			Total
		Bottle Broken	Bottle Cracks / Chunk	Volume No Standards	
1	August	243	464	448	1 146
2	September	235	828	344	1,407
3	October	240	642	211	1,093
4	November	235	884	169	1,288
5	December	236	669	302	1,207
Total		1,180	3,487	1,474	6141

From Table 2 shows that the products produced during 5 months of disability each month, and the need to do data processing in order to get the problem bottle nonstandard most dominant, which is then analyzed so can achieve an optimal solution. The data will be processed in this research is data in Table 2 bottles of nonstandard form of data. The following stages of data processing is done:

3.1. Stages Plan

Step 1: Define the Problem
The problem presented in tables 3

Table 3: Table stratification product of not standard TBS

No.	Product Photo Standard	Average	Percentage (%)	Cumulative Percentage (%)
1	Bottle Chunk / Cracks	697	56.76%	56.76%
2	Volume Not Standard	295	24.02%	80.78%
3	Broken Bottle	236	19.22%	100%
Total		1,228	100%	

Step 2: Finding All possible cause
Cause-effect Diagram (Sudjana, 1996)
After determining the subject matter, we then look for factors that might be causing the product is not standard bottle chipped / cracked on causal diagram. Generally, there are five factors that can cause the product to be nonstandard, namely: human factors, factors working methods, machinery factors, material factors and environmental factors. The results of the standard product does not cause the bottle chipped / cracked found in the field when the production takes place, which is in the filler machine and crowner.

1. Human Factors, In human factors found causes that bottle chipped / cracked, namely:
   a) lack of concentration, a known cause of the decline in the concentration of filler machine operators and crowner during the production process is fatigue and lack of hours to rest. This is caused by only one person guarding operator and crowner filler machine, thus causing less meticulous workmanship at the time of charging is completed bottle that causes the bottle not enter simultaneously with the crown.
   b) Lack of experience, the operators who have recently graduated and has no experience in working. This resulted in a lack of operator skill to operate the machine.
2. Factors Material, In the material factors found several causes that bottle chipped / cracked, namely:
   a) hadling, setting on hadling crown was extremely influential in the smooth production, if the setting on hadling crown is not exactly the crown that goes into the tube crowner too much resulting crown was damaged although good processing engine.

b) Crown dirty / PVC damaged, the torn cardboard that come into the crown caused drug not be checked when the crown is inserted which resulted crown so dirty / damaged PVC crown.

3. Factors Engineering, In machine factor found several causes that bottle chipped / cracked, namely:
   a) Setting is not appropriate, at the time of scheduling maintenance, there are engine parts filler and crowner are not being checked properly by operators such as:
   b) checking the parameters stopper which resulted the position of the stopper is not appropriate because of the bottle and the crown did not go simultaneously in crowner.
   c) Checking the tightness of the cover screws crown chute is aligned and meeting or not, resulting in the flow path of the crown chute changed too deep.
4. Factors Working Methods, At factor working methods found the cause of which could result in the bottle chipped / cracked, namely:
   a) drug Inlet crown too sticky, there is no system for checking inlet that supports the crown so it is unknown drug inlet too sticky or not.
5. Environmental Factors. On the found to cause environmental factors that can result in the bottle chipped / cracked, namely: motion cramped space, production space in the operator feel less comfortable and the space is cramped. This is because the filler machine and crowner blocked conveyor, so that the bottle chipped / cracked into the engine is not known.

3.2. Dominant Cause Analysis

In this step provides a ranking on the factors that cause the most dominant thought for a bottle chipped / cracked, using causality analysis brainstorming tables as shown on table 4.

Table 4. Analysis of causes dominant in brainstorming

No.	The dominant cause	Member of Value			Total Value	Ranking
		Bambang	**Ashar**	**Wahyu**		
1.	Improper stopper Position	23%	27%	25%	75%	I
2.	The flow path of crown chute too deep	6%	4%	5%	15%	II
3.	Crown dented / damaged	3%	4%	3%	10%	III
Total		**32%**	**35%**	**33%**	**100%**	

Step 3: Test the main cause

to find out the main causes of disability do with the tabulation process at the check cheet and then do the stratification process, following in the show pda tables 5 and table 6.

Table 5. Check sheet of testing main cause (unit bottle)

No	Data	Causes Dominant			Total
		Stopper Position Not Exactly	Flow Tracks of Crown Too Deep	Crown Dent / Damaged	
1	Week 1	0	0	0	0
2	Weeks 2	2,184	361	140	2,685
3	Week 3	3171	497	177	3,845
4	Week 4	2,567	437	176	3,180
5	Week 5	3,835	634	241	4,710
6	Week 6	0	0	0	0
Total		11 757	1,929	734	14,420
Ranking		I	II	III	

Table 6. Stratification of testing major cause

No.	The dominant cause	total disability / bottle	Total disability / crates	Percentage (%)	Cumulative Percentage (%)
1.	Improper stopper Position	11 757	1.110	81.53%	81.53%
2.	The flow path of crown chute is too deep	1929	182	13.38%	94, 91%
3.	Crown dented / damaged	734	69	5.09%	100%
Total		**14,420**	**1,362**	**100%**	

Step 4: Make aimprovement Plan
Plan improvements with 5W and 1H methods (Prihantoro, 2012) are shown in table 7 below:

Table 7. Matrix improvement plan 5W-1H

No.	WHAT (Source Cause)	WHY (Reason Repair)	WHO (Responsible)	WHERE (Location)	WHEN (Time Frame)	HOW (Solution Chosen)
1.	Improper stopper Position	crown incoming order amount according to the number of bottles that go	1. Bambang Adi .P , 2. Rizal Wahyu .P.	Machine Filler and Crowner	May 2017	Setting the timer position / distance stopper
2.	The flow path chute crown too deeply	Reduce crown lodged on chute tracks	1. Ashar Sepiawan 2. Rizal Wahyu .P.	Machine Filler and Crowner	May 2017	Reducing the crown chute track groove depth

Stages Do
Step 5: Implement Improvement Measures.
Improvement measures carried out at the crown stopper and the groove are shown in table 8 and table 9. Stages

Table 8. Planned improvements in stopper

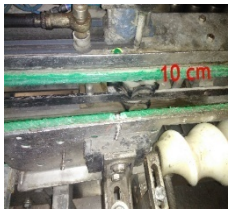
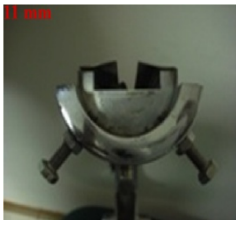
No.	Cause	Before Improvement	After Improvement
1.	The stopper position is not exactly	Distance stopper with crowner 10 cm 	Distance stopper with crowner to 5 cm 

Table 9. Flow Improvement Plan on Crown

No	Cause	Before Improvement	After Improvement
1.	Flow crown chute too deep	Into the groove along the 11mm 	milling process is carried out in the groove as deep as 1 mm, so that the groove depth being 10 mm 

Chec*k*
Step 6: Evaluate Hasi Repair.After the repair process in the previous step and then do the evaluation process improvement results, shown in Table 10.

Table 10. Check sheet product evaluation standard bottle photo chunk / cracked after repair (bottle unit)

No.	Cause	Week 1	Week 2	Week 3	Week 4	Week 5	Total
1.	Improper stopper Position	534	371	342	334	0	1 581
2.	The flow path of crown chute is too deep	0	0	0	0	0	0
3.	Crown dented / damaged	13	15	8	11	0	47
Total		547	386	350	345	0	1 628

Table 11. Comparison of total disability before and after repair

No.	Dominant Cause	Before Improvement		After Improvement	
		Number of defects / bottle	Total disability / crates	Number of defects / bottle	Total disability / crates
1.	Improper stopper Position	11,757	1,110	1,581	164

2.	The flow path is too deep crown chute	1,929	182	0	0
3.	Crown dented / damaged	734	69	47	5
Total		14,420	1,362	1,628	169

3.3. Stage Action

Step 7: Standardizedimprovement
processlast in this research is to set the standard repair to obtain maximum results with the lowest defective rate. Comparison of the total disability before and after repair is shown in table 11 and the Comparison evaluation results before and after standardization is shown in table 12.

Table 12: Comparative evaluation results before and after standardization

No.	Dominant Cause	Prior Standards	AfterStandards	Number of defects / bottle	Total disability / crates
		Number of defects / bottle	Total disability / crates		
1.	Improper stopper Position	1.581	164	773	65
2.	Theflow path chute too deep crown	0	0	0	0
3.	Crown dented / damaged	47	5	49	4
Total		1,628	169	882	69

4. Conclusion

Based on research that has been done can be concluded that:

1. Method PDCA-8 steps, appropriate to be used in the bottling line quality control process PT. X. The results obtained based problem solving PDCA-8-step method is the
   a) type most common defect in the process of bottling line TBS is bottled chipped / cracked that reached 697 crates or 56.67% during the month of August to December 2017.
   b) Finding the cause of the product is not standard bottles chipped / cracked and found three dominant factors causing nonstandard product that is the position of the stopper that is not appropriate, the flow path chute too deep crown and crown dented / damaged.
   c) The third test of the causal factors and find the position of stopper exact and the groove track crown chute too in contributing to the number of defects at most, with the number 1110 182 81,53dan crates or crates or 13.38%
   d) Make improvement plans of the two factors that will be repaired by change settings position timer / distance stopper and reduce the track groove depth crown chute and specify a target decrease of 70.92%.
   e) Carrying out repairs on the stopper by shifting the distance between the stopper with crowner to 5 cm and reducing the groove depth crown chute being 10 mm.
   f) Seeing the results of the evaluation before repair and after repair, the losses caused by these two factors are the dominant cause is handled before repairs amounted to 1,392 crates down to 169 crates or a decrease of 1,193 crates and total percentage of 87.59% decline so that the target of a decline of 70.92 % successfully surpassed.
   g) Establish standardized on stopper by checking the parameter settings stopper and standardizing the groove crown chute by checking the bolts on the cover crown chute.
   h) After standardization acquired defect reduction as much as 69 crates. Where prior to the enactment of standardization, the number of defects were 169 crates or down by 100 crates of after standardized.
2. Factors that influence the occurrence of product defects in the process of bottling TBS PT. X namely:
   a) Human Factors. Lack of concentration, a known cause of the decline in the concentration of filler machine operators and crowner during the production process is fatigue and lack of hours to rest. This is caused by only one person guarding operator and crowner filler machine, thus causing less meticulous workmanship at the time of charging is completed bottle that causes the bottle not enter simultaneously with the crown. Lack of experience, the operators who have recently graduated and has no experience in working. This resulted in a lack of operator skill to operate the machine.

b) Material factors. Handling, setting the crown hadling very influential on the smooth production, when setting the crown hadling not exactly the crown that goes into the tube crowner too much resulting crown was damaged although good processing engine. Crown dirty / PVC damaged, the torn cardboard that come into the crown caused drug not be checked when the crown is inserted which resulted crown so dirty / damaged PVC crown.
c) Factors Engineering. Set up not appropriate, at the time of scheduling maintenance, there are engine parts filler and crowner are not being checked properly by operators such as: checking the parameters stopper which resulted in the position of the stopper is not appropriate because of the bottle and the crown did not enter simultaneously in crowner , Checking the tightness of the cover screws crown chute is aligned and meeting or not, resulting in the flow path of the crown chute changed too deep.
d) Factors Working Methods. Drug Inlet crown too sticky, there is no support system for checking the inlet at the crown so it is unknown drug inlet too sticky or not.
e) Environmental Factors. Motion cramped space, production space in the operator feel less comfortable and the space is cramped. This is because the filler machine and crowner blocked conveyor, so that the bottle chipped / cracked into the engine is not known.

Based on the above conclusions, some suggestions are given:

1. Add 1 operator on the machine and crowner filler.it is meant when one person operator fatigue when doing production, can be replaced by other workers, so workers have adequate rest periods.
2. For companies, it is expected to provide guidance or dissemination to all employeesmachine, and crowner filler so that employees have a good ability to operate machinery.
3. Installing standardization work steps, as well as putting work tools in an easily accessible place, so that when the necessary repairs can be made quickly and accurately.
4. For companies expected, evaluating and revising standardization and when deemed necessary.
5. For companies are expected to continue to increase efforts to improve the work step towards the use ofmachine. filler and crowner.

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Biographies

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