



CONTROL ANALYSIS OF SUGAR PACKAGING BY USING OF SEVEN TOOLS

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ABSTRACT

Quality is a factor that can increase product competitiveness. In improving products quality is necessary to control the quality (Quality Control) of the process activities. This study aims to determine the quality control of granulated sugar packaging process by using the seven tool method consisting of check sheet, histogram, Pareto chart, flow chart, scatter diagram, control chart and fishbone diagram. From 30 days observation concluded that the highest type of damage consist of metal detection by 145 bags and torn packaging by 50 bags. Then, from the results of control chart known that out of control process still happen. Both types of damage then revised, and process capability analysis is carried out, so can be concluded that the process is not capable in making the product according to specifications. Therefore, an analysis using fishbone diagram shows that the causes of damage are human, working methods, and machines. From these factors, Standard Operating Procedures can be done as well as designing new machines in packaging process.

Keywords: Fish Bone, 7 Tools, Quality, Packaging

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1. Introduction

Sugar is a strategic commodity for Indonesia. Competition in granulated sugar industry in Indonesia is getting tighter because the demand of industrial sugar is increasing in medium and large-scale industries, especially in food and beverage industries. This is closely related to how good the product quality received by consumers, which causes the company to maintain product quality, or even better. One of the activities in creating the quality to fit the set standards is by implementing an appropriate quality control system. Quality control aims to obtain consistent output quality according to desired product specifications, and meets the requirements set by consumers, which can increase consumer trust and satisfaction.

Makassar Tene Ltd is the first and the only one granulated sugar factory operating in eastern area of Makassar. Granulated sugar industry grows along with the growth of food and beverage industries that use sugar as ingredient. PT Makassar Tene is capable of producing up to 1,800 tons of granulated sugar per day to meet the needs in eastern Indonesia. To produce granulated sugar, the company certainly needs Raw Sugar as the raw materials. So far, the company refers to the Indonesian National Standard (SNI 3140.2: 2011) in carrying out its industrial activities. During the packing process, rejected granulated sugar still exist, while packing is one of the processes with quality requirements determined by the company to meet consumer satisfaction.

In July 2019, the sum of packaging were 596,979 bags and the number of damaged product were 226 bags or 0.03%. The types of damage occurred in the packing process including sewing failure, metal particles detection and damaged

packaging. From the total damage, product damage is still within company's tolerance limit because the standard percentage of damage set by the company is 0.02% for each production process. However, quality control is carried out to further reduce the damage.

Therefore, one of the methods is analyzing the quality control by looking for damage causes, then finding improvement solution using 'seven tools', so that the percentage of rejected products can be kept as low as possible and able

to meet the specifications of refined sugar products.

2. Research Methods.

2.1 Research Place and Time

The research was conducted in packaging process of PT. Makassar Tene in Ir. Sutami Street number 38, Makassar, for approximately one month, in July 2019.

2.1.1 Data Sources

The sources data of this research were secondary data in form of company history, packaging history, and damage in packaging process.

2.1.2 Research Design

The design of this research is descriptive research, which only making predictions or looking for the way to solve the existing problem based on data. The first thing was identifying packing process, followed by collecting the data on the sum of packaging and damages which consisted of sewing failure, metal particles detection and damaged packaging in unit of tonnes and bag. 1 bag equal to 50 kg. Identification was carried out from the start in order to make problems mapping, to the formulation of proposed improvement using 'seven tools' method. Data processing and analysis were carried out using the tools of the 'seven tools' method including:

1. Check Sheet, This tool shows the data of type and sum of damage in July 2019, in form of check sheet.
2. Histogram, This tool displays the data from the check sheet in form of block graph.
3. Pareto Chart This tool find the highest type of damage.
4. Flow Chart, This tool shows the steps or process to simplify a system which display the flow process of granulated sugar packaging process.
5. Scatter Diagram (Scatter Chart), This tool find the correlation between packaging number and highest damage type. The formula of correlation coefficient (r) between two variables, as follow :

$$r = \frac{n\sum xy - \sum x \sum y}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

n = Sum of data

x = Sum of production

y = Product damage

6. Control Chart, The control chart used is p-chart (proportion control chart for damage), followed by the process capability analysis, as follows :

$$P = \frac{np}{n}$$

P = Proportion of defective products in the sample / subgroup

N = Sum of all samples or subgroups

np = Sum of defective products in the sample / subgroup

Standard deviation : $S = \sqrt{P \frac{(1-P)}{n}}$, if P is in

percentage, then $S = \sqrt{P \frac{(100-P)}{n}}$

3-sigma limits :

$$CL = \bar{p} = \frac{\sum np}{\sum n}$$

$$UCL = \bar{p} + 3 \sqrt{\bar{p} \frac{(1-\bar{p})}{n}} \text{ or } \bar{p} + 3 S$$

7. Cause and Effect Diagram, Cause and effect diagram in this case will identify the causing factors of damage which grouped into Material factor (raw material), Machine, Man (labor), Method, and Environment.

3. Result and Discussion

3.1 Results

1. Check Sheet

In check sheet shown daily sum of damaged product during packaging process throughout July 2019, which can be seen in table below :

Tabel 1. Check Sheet of Damage in Granulated Sugar Packaging in July 2019

Produk : Sugar				Mount : Juli 2019		
Location : Proses Bagging				Time : Shift 1 - 3		
No	Damage	Frekuensi (Bag)				Total
		Week -1	Week-2	Week-3	Week-4	
1	Sewing Failed	II	IIII II	IIII II	IIII II II	31
2	Metal detected	IIII IIII IIII II IIII II III	IIII IIII IIII II IIII IIII IIII II III	IIII IIII IIII II IIII IIII IIII II IIII IIII IIII II	IIII IIII IIII II IIII IIII IIII II	145
3	Torn Packaging	III	IIII IIII	IIII IIII II II	IIII IIII IIII II I	50
Total Damage (Bag)						226

2. Histogram

The data collected from the observation was made into histogram that overviewed the frequency of each type of damage, which were sewing failure, metal detection and torn packaging. The diagram is seen in the image below:

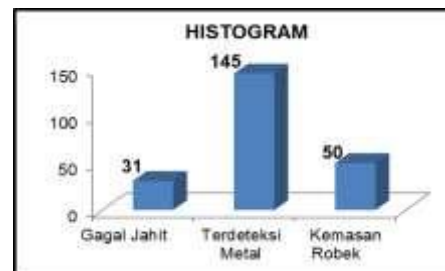


Figure 1: Histogram of Damaged Packaging

3. Pareto Chart

This chart drew the comparison of sewing failure, metal detection, and damaged packaging towards total damage sorted,

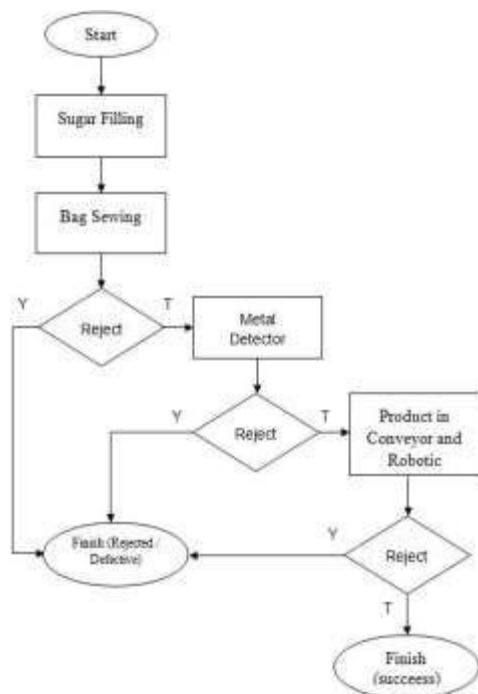
based on the largest number of damage in granulated sugar packaging process. The percentage and cumulative percentage were then calculated, as follow :

Tabel 2. The Percentage of Damage of Granulated Sugar Packaging Process

Damage	Sum Damage (Bag)	Damage Percentage (%)	Comulatife (%)
Metal Detection	145	64,16	64,16
Torn Packaging	50	22,12	86,28
Sewing Falied	31	13,72	100,00
Sum	226	100	

4. Flow Chart

The flow chart described the detail and clear steps or sequence in the process of granulated sugar packaging process. The chart can be seen below :



Y = Yes
N = No

Figure 3. Flow Chart of Granulated Sugar Packaging Process

5. Scatter Diagram (Scatter Chart)

Here, scatter diagram was divided into 2 correlations which were the correlation between the sum of packaging and metal detection, and the correlation between the sum of packaging and torn packages.

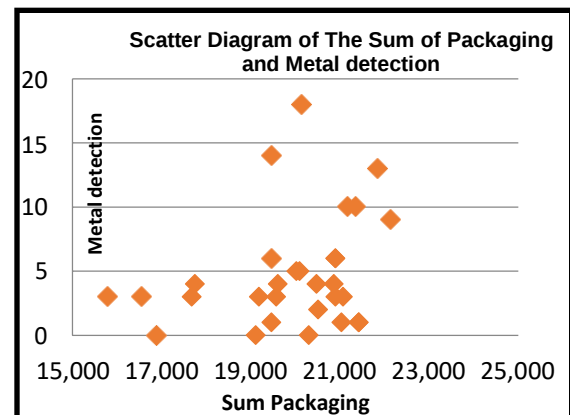


Figure 4: Scatter Diagram of The Sum of Packaging and Metal detection

From the calculation results, the correlation coefficient was 0.28 which meant between 0 and +1. The next correlation is between the sum of packaging and torn packages, which can be seen in the image below:

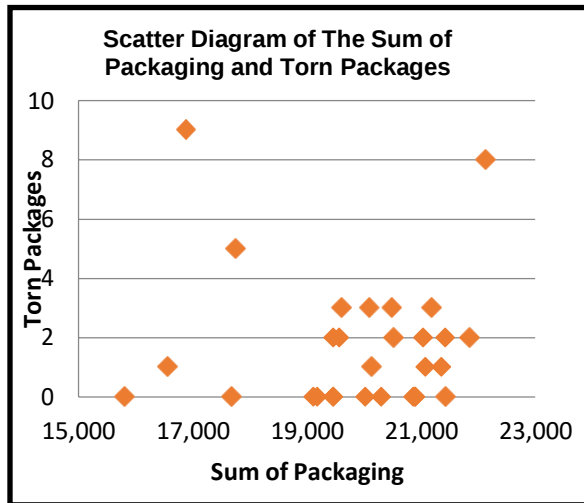


Figure 5. Scatter Diagram of the Sum of Packaging and Torn Packages

From the calculation result, the coefficient was - 0.05

6. p-Chart (p Control Chart)

From the calculation results of both highest types of damage, the results of p-chart analysis can be seen below

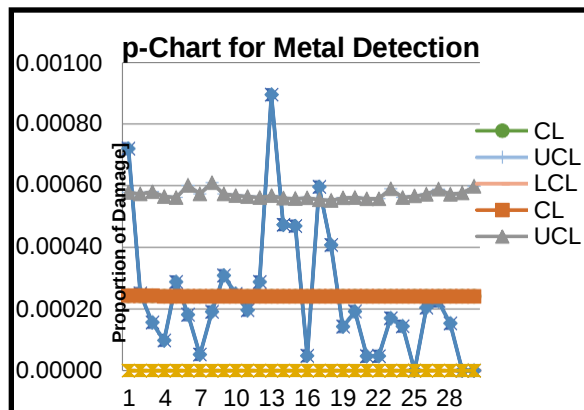


Figure 6: p-Chart for Metal Detection

The results of the control chart (p-Chart) above show that there are points that out of the upper control limit (out of control) but still within the tolerance limit because the LCL value = 0. Therefore, p- chart needs to be revised by deleting out of control data, as shown below:

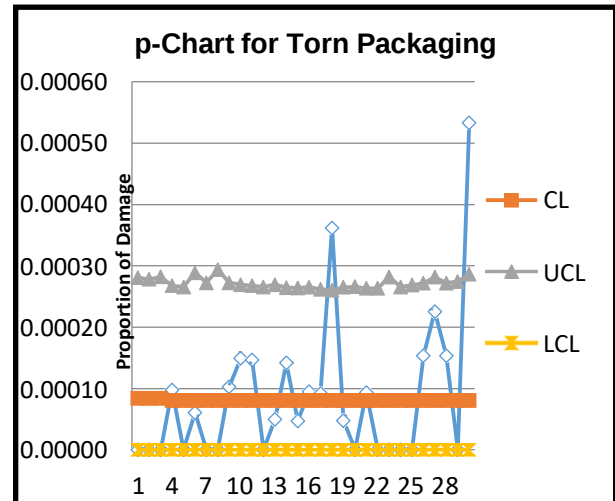


Figure 7: p-Chart for Torn Packaging

The results of the control chart (p-Chart) above show that there are points that out of the upper control limit (out of control) but still within the tolerance limit because the LCL value = 0. Therefore, p- chart needs to be revised by deleting out of control data, as shown below ;

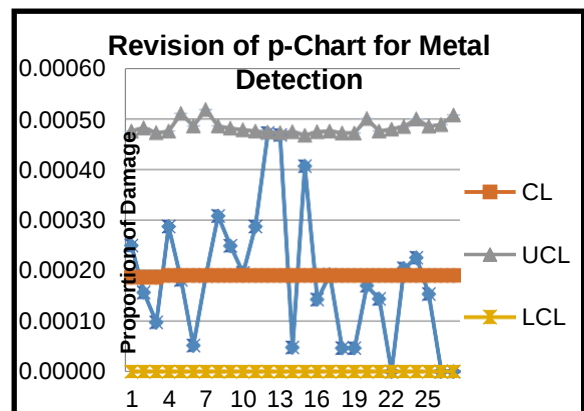


Figure 8: Revision of p-Chart for Metal Detection

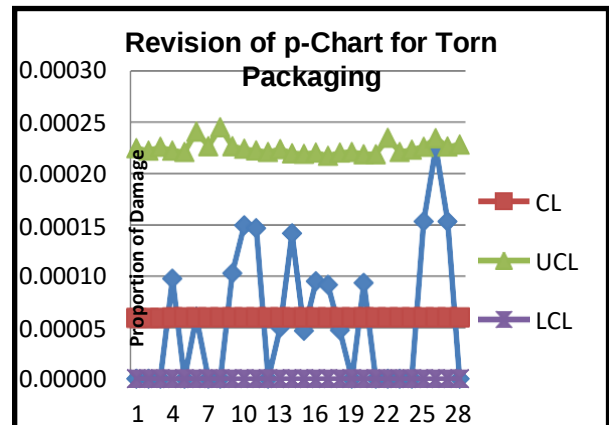


Figure 9: Revision of p-Chart for Torn Packaging

Revision of p-Chart shown that the process was in-control. After that, process capability analysis was carried out, resulted in metal detection as $C_p = 0.99981$ and torn packaging as $C_p = 0.99994$, thus the packaging process of granulated sugar could not produce the products according to specifications because $C_p < 1$.

7. Cause and Effect diagram, The cause of problems in here to put into consideration were human, working method, and machine, which could be seen in fishbone diagram below:

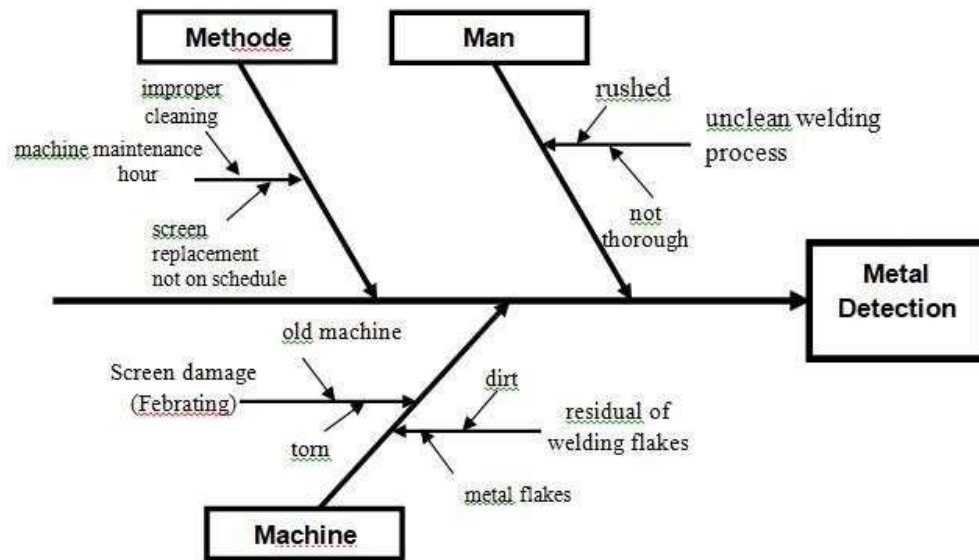


Figure 10: Cause and Effect Diagram on Metal Detection

The next is torn packaging, which can be seen below:

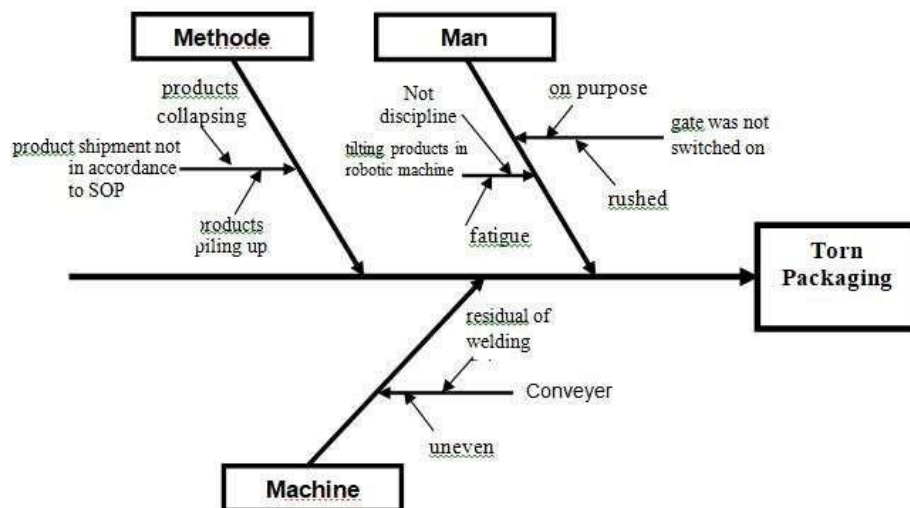


Figure 11: Cause and Effect Diagram on Torn Packaging

3.2 Discussion

1. Check Sheet

In granulated sugar packaging process or bagging could be seen that the damage happened in July 2019 were 31 bags of sewing failure, 145 bags of metal detection, and 50 bags of torn packaging, indicated that there were total 226 damaged bags from shift 1 -3 of July 2019.

2. Histogram

The histogram shows the data of overall damage on granulated sugar packaging process firmly and clearly through bar charts. They were damages on sewing failure of 31 bags, metal detection of 145 bags, and torn packaging of 50 bags. The histogram showed the urgency to take corrective action in order to control the quality of granulated sugar packaging process.

3. Pareto Chart

From the diagram can be seen that the percentage of damage from metal detection of 64.16% and torn packaging of 22.12% are the most dominant cumulative percentage. Thus, to solve the damage problem in packaging process, the most dominant type of damage which are metal detection and torn packaging must be resolved by identifying the causes so that the problem can be overcome significantly.

4. Flow Chart

The chart shows that when completing each stage of packaging process, whether the product to be said rejected or not will be decided. The products said as rejected

when failures found at sewing stage, metal was detected at metal detectors, and the packaging was torn during product delivery on conveyor and robotic machine. Therefore, when one of the stages is declared as rejected, the packaging process said as finished, means that the product is categorized as rejected / defective and would be re-processed. However, if the product is not declared as rejected, the process will continue until the last stage of packaging process to completion (success) so that the product is concluded as finished and ready for sale.

5. Scatter Diagram (Scatter Chart)

From the analysis was found that the correlation coefficient value between the sum of packaging and metal detection was $r = 0.28$, indicated that the positive correlation in weak category meant that if the value of metal detection (X) increased, then the value of sum of packages (Y) would also increase. From those two variables, there might be influences from other factors (cause and effect). Meanwhile, the correlation coefficient between the sum of packaging and torn packages was $r = -0.05$, indicated that the correlation between those two variables showed negative correlation. It means that if the sum of packaging (X) are increasing, then the sum of damage (Y) of the products to decrease is possible.

6. p-Chart (p Control Chart)

From the results of p control chart could be seen that out of control process still exist, thus revisions were made in order to carry out process capability analysis in order to determine whether the product

already met the specifications or not, and produced $C_p < 1$ which meant that packaging process was unable to yield the products that met the specifications. Therefore, further improvement or analysis is needed to increase process capability so as getting better results by using cause and effect diagram (fishbone diagram).

7. Cause and Effect Diagram (Fishbone Diagram)

Refers to the fishbone on metal detection of human factor, the suggestion or solution is to resocializing the use of Standard Operating Procedures to workers and carry out strict supervision when they perform maintenance. Factor of proposed method or solution is drafting the maintenance scheduling method for screen machine to keep them in good condition. Then the factor of proposed machines or the solutions is to scheduling routine and regular checking for the feasibility of machine's function and cleanliness.

Whereas, the fishbone on torn packaging of human factors, the suggestion or solution is to do more supervision for the gate to always activated, and positioning of product placement on robotic machine. Factor of proposed method or solution is that worker should pay more attention and understand the Standard Operating Procedures very well, so that product damages do not occur. Then for machine factor, the proposed methods or solutions are to check the conveyor machine immediately after welding activities, and replace or change the design of conveyor machine so that the moving position of product is straight into robotic machine,

thus the damage such as torn packaging can be minimalized.

4. Conclusion

Based on the results of research and discussion regarding quality control of granulated sugar packaging process can be concluded that :

1. The results show that the high damages are metal detection by 145 bags and torn packaging by 50 bags. After that, the identification results for the cause of damage by using cause and effect diagram are human factors such as the level of cleanliness during maintenance, the gate is not turned on, and the product in robotic does not in right position; method factors such as machines maintenance and product's sending or moving process are not according to SOP; and machine factors such as screen damage (febrating) and the remnants of welding residual stuck in the machine and conveyor machines.
2. Suggestions or solutions that can be given are for human factor, which is by socializing and giving direction regarding Standard Operating Procedures and increasing the supervision to workers. Then for the method factor, which is by compiling or updating Standard Operating Procedures for maintenance process and scheduling, and the method of products transferring to robotic machines. As for machine factor, the suggestion is making a

new design of conveyor machine in straight and even position for the products towards the robotic machine for its normal positioning. The expectation is that the suggestions can be the solutions to minimalizing the level of damage that occurs, and can improve the quality of granulated sugar packaging process.

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