DEFECT REDUCTION ANALYSIS TO IMPROVE GLASS BOTTLE PACKAGING PRODUCTS QUALITY USING STATISTICAL PROCESS CONTROL (SPC) AT PT. MULIAGLASS CONTAINER (MGC)

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Abstract

Quality plays an important role in business steps throughout the company, to become stronger and stronger in the world market the company must be able to increase efficiency and client or customer loyalty and product excellence. Problems in the amount of production in production caused by various factors that cause a decrease in quality so that it has an impact on a decrease in profits. To prevent an increase in this defective product, it is necessary to evaluate the most types of defects to determine the cause of the defect so that corrective action is obtained using the statistical process control (SPC) method and with 3 Pareto diagram controllers, control charts and fishbone. This research is to find facts about Defect Reduction Through statistical process control (SPC) for the Quality of Glass Packaging Products of PT. Muliaglass Container (MGC) this helps to know the view in reducing the number of products so that they can determine good product quality targets. The implementation of the results of this study shows a fairly good decrease in production on the basis of improvements from the calculation results, namely before repairs from January to March 2021 total defects are 550,962 pc and after repairs in January to March 2022 total defects are 496,260 pc so a decrease of 10% with a cost of Rp. 711,816,014/year.

INTRODUCTION

Undeniably though competition in today's world market is a matter of great change and a tremendous requirement for sustainable business progress (Sheikh, 2018). Quality plays an important role in the steps of business throughout the company, to become stronger and stronger in the world market the company must be able to expand the efficiency and loyalty of clients or customers and expand the advantages of a product. Quality control is an engineering and management activity that measures the quality of the output (goods and/ or services) (Handes et al., 2013). In this way, the business world continues to seek excellence because of the needs and assumptions of the client or customer (Gejdoš, 2015). So that in the company
the importance of good quality greatly affects the growth rate of the company itself (Mahtani & Garg, 2018). Moreover, there is an increasing demand for returnable packages from many industrial (Tua et al., 2020). Seeing this, PT. Mulia Glass Container (MGC) which is a company engaged in manufacturing, is a glass bottle packaging production company, but in its production there are still problems in the number of defects in production caused by various factors, companies that run the production process to meet consumer demand or customers by dividing working hours into 3 shifts in a day where each shift has 8 hours of working time which is carried out continuously for 7 working days. And in this production process, there are still many defects in the products produced. The number of defects can be seen from the production report table at the Container 1 (C1) and Container 2 (C2) factories. And it can be seen from the number and type of defects that can be seen from the table.

**Table 1**

Production Defect Reports from January to March 2021

| Description | Shift 1, 2, 3 | 1,112,000 | 1,159,056 | 71.79% | 47,056 | 41.14% | 61,168 | 58.85% | 5,215 | 2.11% | 10,269 | 11.12% | 1,222 | 0.72% | 3,763 | 1.70% | - | 0.00% | 17,812 | 7.53% | 2,682 | 1.51% | 1,230 | 0.51% | 113 | 0.05% | - | 0.00% | 29,550 | 37.60% | 9,575 | 4.38% | 359 | 0.17% | 589 | 0.28% | 221 | 0.10% | 134 | 0.08% | 510 | 0.24% | 3,170 | 1.45% | 173 | 0.08% | 375 | 0.16% | 4,044 | 1.82% | - | 38.21% |
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From the observations that can be seen from the table above and the Pareto diagram that the number of defects in the production report for a period of 3 (three) months from January, February, and March there is a number of defects in the production of glass bottle packaging which is still quite high, namely in the range of 20 percent and with The average production efficiency level is around 71.79 percent. By looking at this, the problem of defects found in the production of glass bottle packaging at the container factory 1 and 2, which is caused by several factors, makes research to be conducted as for the purpose of this research in order to identify the types of defects that occur as well as to find out the causes of these defects and also obtain solutions to reduce the number of defective products. And below is a table of the dominant defects from several checks on the production process, both by machines and humans visually.

Table 2
Actual versus Target dominant defect for three months January – March 2021

| No | Dominant Defects | Date       | Number of defects | Defects |  | January (%) | February (%) | March (%) |
|----|------------------|------------|-------------------|---------|  | Actual | Target | Actual | Target | Actual | Target |
| 1  | Split Finish     | 01-Jan-21  | 54                | 0,16    | 10 | 7,12  | 10     | 2,10   | 42,96 | 10     | 35     | 50     | 10     |
|    |                  | 01-Feb-21  | 278               |         | 10 | 2,85  | 20     | 13     | 35     | 50     | 10     | 2,10   | 42,96  |
|    |                  | 28-Feb-21  | 423               |         | 10 | 7,12  | 10     | 2,10   | 42,96 | 10     | 35     | 50     | 10     |
|    |                  | 01-March-21| 555               |         | 10 | 2,10  | 42,96  | 10     | 35     | 50     | 10     | 2,10   | 42,96  |
|    |                  | 31-March-21| 1,481             |         | 10 | 7,12  | 10     | 2,10   | 42,96 | 10     | 35     | 50     | 10     |
| 2  | Mould Number     | 01-Jan-21  | 714               | 6,96    | 10 | 40,86 | 15     | 1,149  | 2,852 | 1,795  | 1,562  |
|    | Reader           |            |                   |         |    |       |        |        |        |        |        |        |
To prevent this increase in defective products, it is necessary to evaluate the most types of defects to find out the causes of product defects so that corrective actions are obtained using statistical process control (SPC) (Fouad, 2010). Based on the research background that quality improvement is a very important factor for the achievement and development of every company. Thus, it is important to study and analyze in this bottle production process area because there are still many defects found in bottle products and data were obtained in January, February and March 2021. Furthermore, in carrying out the right Statistical Process Control (SPC) strategy in order to complete every difficulty. So the researchers identified the problem formulation into 3 (three), namely:

1. What are the results in minimizing defects in the production of glass bottle packaging?
2. What are the causes of defects and solutions in handling by applying SPC to reduce defects in glass bottle packaging products?
3. How to measure defects and carry out repair and monitoring processes using statistical process control (SPC) methods as well as 3 controllers?

This research is to identify or describe a concept to explain predicting a situation that indicates the type of study to be carried out, in terms of answering the problem formulation are:

1. To find out from efforts to minimize defects in the production of glass bottle packaging.
2. To find out the challenges and solutions to the application of SPC in improving the quality of glass bottle packaging.
3. To find out the efforts of planning, implementing and supervising the SPC method at PT. Muliaglass Container.

The use of SPC in this study can specifically find out the causes and steps to fix it and with this research using the SPC tool can be a final product control tool and to check machine maintenance needs, increase market competence and productivity, using the application of the U-chart control chart.

**METHOD**

Data analysis in this quantitative study is a result of data processing on problems with defects in glass bottle packaging products in the container 1 and container 2 factories at PT. Muliaglass Container. After the data from the production reports in January, February and March were obtained, the researchers conducted an analysis by grouping them on several variables, presenting data for each variable studied, and performing calculations to answer the problem formulation. Data analysis is also used to test using control charts in order to obtain an overview of the production process. This control chart is used to understand whether a production process is running under controlled conditions or not.

The design of this research is descriptive with a quantitative approach because it allows the collection of data analysis data by describing or describing data from the results of production reports in January, February and March. The quantitative research approach is because the research data is in the form of numbers (Agung et al., 2019). This study is intended to explore facts about Reducing Defects in Processes Through Statistical Process Control (SPC) for Improvement and Supervision of the Quality of Glass Bottle Packaging Products at PT. Muliaglass Container (MGC) is to help determine the view in reducing the number of defects in the product so that it can increase efficiency targets.

The research variables are: an object or product value that has a certain variation determined by the researcher to be studied and drawn conclusions (Agung et al., 2019).
Variables used
1. Dependent variable: The independent variable is a variable that is deliberately regulated by the researcher as an action to be tested because as an output variable, the criteria, the consequent variable in this study is the implementation of the findings (Y)
2. The independent variable is a result or impact of the results of the application of the independent variable. The independent variables in this study are the quality and organizational culture (X1 and X2)

Operational Variable
Operational variables are needed to determine the types and indicators of the variables involved in this study (Singh & Singh, 2015). Operational variables aim to determine the scale of measurement on each of these variables, so that hypothesis testing using tools can be carried out correctly. Operational definitions of the variables to be studied are increasing:
1. Quality (X1)
   Quality is to show that a product conforms to certain physical characteristics defined by certain specifications
2. Organizational Culture (X2)
   Encouraging employees to be more innovative and willing to take risks. Because, every member of the organization has a high level of responsibility, is free to work and has many opportunities for initiative within the organization
3. Implementation of findings (Y)
   Implement and realize the plans that have been prepared into a real form. In preparing a plan, the objectives to be achieved are also drawn up.

| Table 3 | Independent variables X1 = Quality |
|---------|-----------------------------------|
| Variable | Dimension | Indicator | Item Scale |
| Quality (X1) | Performance | Product Specific Functions | Product-specific Function Level |
| Quality is to show that a product conforms to certain physical characteristics defined by certain specifications. |
| Features | Product performance | innovate or product development | Create novelty in glass bottle packaging products |
| Reliability | Durable product | Meets the requirements of glass bottles economically and with reasonable assurance of continuity and quality |
| Conformance | According to standard or specification | Every glass bottle packaging product has a predetermined standard or specification |
| Durability | Effective product life | Customers clearly want products that are of satisfactory quality in the long term |
| Serviceability | Speed, convenience and complaint handling | The product is able to improve good quality compared to the product that is difficult to repair. |
| Estethica | Is the product's visual | Shape and color and beauty are |
Table 4
Independent Variables \(X_2 =\) Organizational Culture

| Variable | Dimension | Indicator                                                                 | Item Scale                                                                                           |
|----------|-----------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Organizational culture (\(X_2\)) | Encouraging employees to be more innovative and willing to take risks. Because, every member of the organization has a high level of responsibility, is free to work and has many opportunities for initiative within the organization. | Culture | Putting quality in all aspects of company operations | Eliminate Waste and defects from operations |
| | | Attitude | People, equipment, suppliers, materials and procedures | Identify and understand problems, test ideas to fix problems, and measure results |
| | | Organization | Identify and understand problems, test ideas to fix problems, and measure results | Leadership by example, Training employees to produce a quality product |

Table 5
Dependent Variables \(Y =\) Implementation of Findings

| Variable | Dimension | Indicator                                                                 | Item Scale                                                                                           |
|----------|-----------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Implementation of Findings (\(Y\)) | Statistical quality control (SPC) | Assess and control the production process | Managing Quality and Eliminating Specific Causes of Variability in a Process |
| | Inspection | Quality Control in Supervision and Control | Inspection through visuals and machines and then test the output process get a higher quality product. |
| | Sustainable | Implement policies and carry out continuous improvement plans | The results of product quality in accordance with the wishes of customers and low cost |

Source: results of research data processing, 2021
The sampling technique in this study used a purposive sampling technique. Purposive sampling is a sampling technique that is often used in research. Purposive sampling is sampling carried out in accordance with the required sample requirements. The sampling is done intentionally by taking only certain samples that have certain characteristics, characteristics, criteria, or properties. Thus, the sampling was not done randomly. Purposive sampling is also called judgmental sampling, which is sampling based on the researcher's judgment regarding who is eligible to be used as a sample (Sugiyono, 2019). Research that takes samples using this technique is required to have a good background knowledge in order to obtain samples that are in accordance with certain characteristics, characteristics, criteria, or properties. Not a few researchers often face problems when the sample to be taken uses a random sampling technique. If the researcher faces a problem like this, then the sampling can be done by purposive sampling. With purposive sampling, it is hoped that the sample criteria obtained are truly in accordance with the research to be carried out (Agung et al., 2019).

RESULTS AND DISCUSSION

For the use of statistical tools is an improvement in a production process and product statistical tools can be obtained without large capital costs but the design will require investment in man hours and in this case an understanding of statistical methods and their limitations is needed how understanding of manufacturing processes and products is very important so that statistical tools can be a control and improvement in the process of making glass bottle packaging using information taken from samples to arrive at conclusions about the nature of the product or process being sampled. And in this study, the data analysis that will be discussed is by using static process control with 3 (three) control devices.

All types of glass bottles are made of the same material, but in terms of the manufacturing process, it all depends on the type of glass to be made. Glass is considered as the main material in the beverage product industry, and furthermore every process in the size of glass bottles is very important. Glass bottles are produced by melting sand and blowing a liquid viscous material into the desired shape using a mold and then cooling it. The process may seem simple, but various technologies are used to achieve defect-free glass bottle packaging.

The most common way of making glass may look simple, but it combines many advances or technology to provide glass that is free from defects. Glass bottles are produced by melting sand and then blowing a liquid viscous material into the desired shape using a mold and then the finished glass bottle is cooled. The process may seem simple, but various technologies are used to obtain defect-free glass bottles in glass bottle manufacturing plants (Suhartini, 2020). Moreover, from the observations obtained data on the types of defects that occur during the production process of glass bottle packaging. The results of this description analysis can be seen as follows. One of the problems that arise in the production of MGC is the high loss of glass due to loss defects of 47,056 pc (41.14%)
in the Forming area and 61,168 pc (58.85%) in the QC area for 3 months (period January 2021 to March 2021).

### Table 6

**Data on the number of loss defects in the production of glass bottle packaging**

| No | Problems                                | Qty  | %     |
|----|-----------------------------------------|------|-------|
| 1  | Forming Lost                            | 47,056 | 41,14%|
| 2  | Rejected by M-Cal (side wall)           | 13   | 7,29% |
| 3  | Rejected by Multi (sealing surface & bottom) | 37   | 19,42%|
| 4  | Rejected by M-1                         | 61,168 | 58,85%|
| 5  | Visual Defect                           | 9,575 | 4,38% |
| 6  | Efficiency                              | 71,79% |       |

Source: PT. MGC (QC.Dept)

In the table 6, item 1 is the loss in the forming area and items 2,3,4,5 are the loss in the QC area. The data is taken at the beginning and end of the month in 3 shifts.

### Histogram

From the histogram, it is known that the average total defect is 4,524 pc which occurs in January to March 2021 with a time range at the beginning and end of the month with data taken in 3 shifts with working hours shift 1 hour 7 – 15.00, shift 2 hours 15.00 – 23.00, shift 3 hours 23.00 – 07.00 so that the dominant type of defect can be known.

### Control Chart

In this study, a control chart is used to determine whether the resulting product defects are still within the required limits (Yemima et al., 2014). Comparison between the number of defects with all observations, namely each product classified as "accepted" or "rejected" (which is considered the number of defective products).
Control chart

| No | Shift 1,2,3 | Xi  | Xi² | X   | Std Deviasi | UCL (3s) | LCL (3s) |
|----|------------|-----|-----|-----|-------------|---------|---------|
| 1  | check ring | 289,722 | 83938,97 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 2  | check under ring | 570,5 | 325470,3 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 3  | check shoulder | 67,888 | 4608,901 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 4  | check body | 209,055 | 43704,23 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 5  | check bottom | 0 | 0 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 6  | split finish | 989,555 | 979220,2 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 7  | split bottom | 149 | 22201 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 8  | other checks | 68,333 | 4669,444 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 9  | under size bore | 6,277 | 39,410 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 10 | thinwall | 0 | 0 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 11 | Mould Number Reader | 1641,667 | 2695069 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 12 | stones | 19,944 | 397,780 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 13 | blister | 32,722 | 1070,744 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 14 | loading marks | 12,277 | 150,743 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 15 | washboard | 7,444 | 55,419 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 16 | haymark | 28,333 | 802,778 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 17 | skin cracks | 176,111 | 31015,12 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 18 | dirty oil | 9,611 | 92,373 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 19 | little blank/mould seam | 20,833 | 434,027 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |
| 20 | Lain-Lain | 224,667 | 50475 | 226,1972 | 411,6789931 | 1461,234 | -1008,84 |

Standard deviation

\[ S = \sqrt{n \sum X_i^2 - (\sum X_i)^2} / (n - 1) \]

\[ S = \sqrt{20 \times 4,243,416 - (4524)^2} / 20 (20 - 1) \]

\[ S = \sqrt{84,868.320 - 20.466.576} / 20 (19) \]

\[ S = \sqrt{64.401.744} / 380 \]

\[ S = 411.68 \]

Control Line

\[ CL = \bar{X} = \sum X_i / n = 4524 / 20 = 226.20 \]

Finding the UCL . value

\[ UCL = CL + (3 \sigma) \]

\[ = 226.2 + (3 \times \sqrt{n \sum X_i^2 - (\sum X_i)^2} / (n - 1)) \]

\[ = 226.2 + (3 \times 411.68) \]

\[ = 226.2 + 1235.04 \]

\[ UCL = 1461.24 \]
Finding the LCL value

\[ \text{LCL} = \text{CL} - \left( 3 \times \sqrt{\frac{n \sum X_i^2 - (\sum X_i)^2}{n(n-1)}} \right) = 226.2 - (3 \times 411.68) \]

\[ = 226.2 - (1235.04) \]

\[ \text{LCL} = -1008.84 \]

From the results of analysis and observations on the control chart, there is a special trend and corrective action is required because there are defects that are beyond the control limits, so corrective action must begin with an investigation in order to obtain the root cause of the defect in the production of glass bottle packaging.

Focus group discussions (FDG)

Table 8

| No | Influence Factors                              | PON | JER | BAR | KOD | AGU | Total | Rank |
|----|------------------------------------------------|-----|-----|-----|-----|-----|-------|------|
| 1  | Knowledge of the maintenance of work equipment facilities | 3   | 2   | 4   | 3   | 2   | 14    | 5    |
| 2  | Material warehouse building roof               | 7   | 7   | 7   | 7   | 7   | 35    | 7    |
| 3  | Raw material machining facilities             | 7   | 7   | 7   | 7   | 7   | 35    | 7    |
| 4  | Glass cullet splattered with waste iron       | 7   | 7   | 7   | 7   | 7   | 35    | 7    |
| 5  | Rusty and corrosive conveyor                  | 7   | 7   | 7   | 7   | 7   | 35    | 7    |
| 6  | Drainage of raw material warehouse            | 2   | 3   | 2   | 3   | 2   | 12    | 4    |
| 7  | Maulding maintenance                          | 3   | 4   | 4   | 4   | 3   | 18    | 6    |

The table 8 is followed by 5 members who provide suggestions and the weight of the control and improvement values after which they are added up and given a ranking value to determine the priority of improvement (Gejdoš, 2015).

The weight of each participant's score from 1 to 7 causes of the dominant problem is determined by the NGT formula:

\[ \text{NGT} = \frac{1}{2} N + 1 \]

\[ = \frac{1}{2} \times 7 + 1 \]

\[ = 3.5 + 1 \]

\[ = 4.5 (5) \]

N = Number of Causing Factors 

Based on the results of the NGT test of the 7 dominant causative factors, the 5 most dominant factors were obtained and the dominant factors were
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1. The roof of the building Material warehouse
2. Raw material machining facilities
3. Glass cullet mixed with iron waste
4. Conveyor is rusty and corrosive
5. Molding maintenance

Fishbone Diagram

![Figure 5. Fishbone Diagram](image)

From this fishbone diagram identify the causes that may arise from a problem and help find ideas for solutions to a problem. And we can see that the machine is the dominant factor in the occurrence of low efficiency and does not reach the target so that it affects the material as the raw material for making glass bottle packaging (Juran & Godfrey, 1999).

| Type       | Action plan suggestions                                                                 |
|------------|----------------------------------------------------------------------------------------|
| Man (operator) | - Must have expertise in identifying the causes of defects before they occur               |
|            |   - Using a machine to filter and separate from impurities                               |
|            |   - Must have a good attitude towards quality improvement.                               |
|            |   - Able to identify damage quickly and accurately and know how to repair it (providing training for operators). |
|            |   - Doing training.                                                                      |
| Machine    | - Preventive maintenance to ensure the machine is always in good condition                |
|            |   - All parts of the silo and conveyor must be properly maintained.                      |
|            |   - Frequent machine checks                                                              |
|            |   - Inspection of molds for wear (moulding)                                             |
|            |   - Preventive maintenance of storage warehouse buildingg                                |
| Material   | - Must use raw materials with appropriate quality                                         |
|            |   - The cullet should be cleaned with an appropriate cleaning agent to remove any contamination that could cause bubbles when the cullet material melts. |
|            |   - Avoid material from corrosive contamination from the collection bucket               |
|            |   - Check the moisture (moisture content) of the sand material <= 6%                     |
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| Type             | Action plan suggestions |
|------------------|-------------------------|
| Environment      | - Avoid sand material from leaking when it rains |
|                  | - Use natural lighting to reduce moisture in the sand |

5W + 2H repair plan table

Table 10
Repair Plan

| Problem                                  | Why                          | What                                      | Where | When     | Who       | How                                      | How Much |
|------------------------------------------|------------------------------|-------------------------------------------|-------|----------|-----------|------------------------------------------|----------|
| Defect Bottle                            | High defect on production packaging bottle glass | Evaluation happening defects in the area machine forming | MGC    | Sep 20-May 21 | Ali       | Inevaluation to mold print bottle party engineering | 100%     |
| Moist sand silica among 8% – 12%         | Roof fiber as function lighting and experience dull |                                | MGC    | Sep 20-May 21 | Ali       | To do repair on the top silo and building support | 100%     |
| Cullet mixed with excorrosive material steel on closing receptacle silo | Check in output cullet silo |                                | MGC    | Sep 20-May 21 | Ali       | To do repair top silo and to do painting return cover silo | 100%     |

Managerial implications

Statistical process control (SPC) is the ability to clearly identify the root of the problem and its causal factors so as to minimize defective products and proposed improvements as an effort to reduce defects or defects in glass bottle packaging products (Edossa & Singh, 2016), including:

1. Repair of the cullet silo that causes contamination of the cullet material with iron material due to the corrosiveness of the storage container.
2. Machines and conveyor roofs cause contamination of the cullet material with iron material due to the corrosiveness of the engine and the roof of the building.
3. Repairing the roof of the storage warehouse causing the high moisture content of the sand

Table 11
Managerial implications

| Causative factor                        | Repair Description                                                           | Cost of repairs | Condition Before Repair | Condition After Repair |
|-----------------------------------------|------------------------------------------------------------------------------|-----------------|-------------------------|------------------------|
| Silo cullet on the top (cover) of the Keropos silo | Replacement and repair of the top silo repair item replacement of the silo cover support structure and silo cover plate replacement | Rp. 130,734,103 | ![Image of condition before repair](image1) | ![Image of condition after repair](image2) |
| Conveyor machine and construction      | Repainting and cleaning of the conveyor                                      | Rp. 96,244,366  | ![Image of condition before repair](image3) | ![Image of condition after repair](image4) |
### Impact of repair

**Table 2**

**Silo, Conveyor, Bucket Repair Results**

| Impact of repair                                                                 | Condition Before Repair | Condition After Repair |
|---------------------------------------------------------------------------------|-------------------------|------------------------|
| Can reduce glass cullet contamination with iron or steel impurities due to damaged containers or silos due to corrosive effects. | The cullet is dirty because there is iron or steel residue that falls into the silo | Clean cullet because it is no longer contaminated with iron or steel |
| Can reduce Moist (moisture content) in silica sand                              | Before repairing the silica sand moisture content of samples | After replacing the roof, the |
Impact of repair

| Condition Before Repair | Condition After Repair |
|-------------------------|------------------------|
| from several vendors 7.26% - 8.17% | moist sand quickly dropped between 4.52% - 4.74% |

| Defect reduction in glass bottle packaging products | 550,952 pc | 496,260 pc |

| Saving Cost | Rp. 711,816,014/year |

The implementation of the results of this study shows that the production savings are quite good based on the results of the above calculations, so that the cost savings of Rp. 711,816,014/year. and there is a fairly good decrease in defects from the previous period of January-March 21 with 10% improvement after the January-March 22 period (54,702 pc). This is the impact of good product results so that customer confidence in PT. Muliaglass Container also increased and we can see in the Pareto diagram below.

![Diagram Pareto]

**Figure 6. Pareto chart of the trend of increasing sales**

If you look at the Pareto chart above, the trend of increasing sales is quite good. This increase is the impact of good product results so that customer satisfaction and trust in PT. Muliaglass Container increased.

**CONCLUSION**

Based on the research background that quality improvement is a very important factor for the achievement and development of every company. Thus, it becomes important to study and analyze and be able to carry out the right Statistical Process Control (SPC) strategy in order to solve any difficulties.

Efforts have been made to minimize defects in the production of glass bottle packaging by making several improvements to the silo cullet and conveyor as well as repairing the replacement of the roof on the silica sand storage area and this has been approved by the executive director as the main person in charge of operations and succeeded in minimizing the total defect according to target is 10% (Suhartini, 2020).

Handling by using statistical process control (SPC) as control of the production process produces results and finds solutions to be implemented and made improvements so that this is in accordance with the company’s vision and mission in a good and sustainable manner so that
the production process and results achieve good results so that satisfaction and trust customers towards glass bottle packaging products of PT. Muliaglass Container increased (Kaban, 2016).

The company will continue to carry out the implementation of SPC optimally and sustainably so that in planning the implementation and supervision of the Statistical Process Control (SPC) method at PT. Muliaglass Container (MGC) can always be implemented in order to create a form of good control of the results of changes and maintain the results of these changes for the sustainability and development of the modern glass bottle packaging industry as well as becoming a low-cost producer in Asia-Pacific (Heizer & Render, 2015).

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