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QUALITY IMPROVEMENT IN THE FILO BOTTLE PRODUCTION PROCESS USING THE SIX SIGMA METHOD AT PT. CAHAYA PERDANA PLASTIK

PERBAIKAN KUALITAS PADA PROSES PRODUKSI PEMBUATAN BOTTLE FILO DENGAN MENGUNAKAN METODE SIX SIGMA DI PT. CAHAYA PERDANA PLASTIK

Ike Karlina[1*], Arief Suwandi[2]

[1*,2]Universitas Esa Unggul, Email : ikeeekrln@gmail.com

*email koresponden: ikeeekrln@gmail.com

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Abstract

This study aims to analyze and identify the dominant causes of failure in the filo bottle production process at PT. Cahaya Perdana Plastik and to propose improvements to reduce the number of defective products. The method used in this study is Six Sigma with the DMAI (Define, Measure, Analyze, and Improve) stages. The data used is defective product data from October 1 to November 31, 2020, in the Injection section. The analytical tools used include P-Charts, Pareto Charts, Cause and Effect Diagrams (Fishbone), and FMEA (Failure Mode and Effect Analysis). The results show that out of a total production of 73,552 filo bottles, 6,819 were defective. The most dominant type of defect is color not according to standard as many as 3,720 units, followed by thin defects as many as 2,204 units, silvermark as many as 515 units, and bubbles as many as 380 units. Based on the measurement results, the DPMO value was obtained at 425,460.64 with a sigma level of 5.41. The results of the Cause and Effect Diagram analysis showed that human factors were one of the main causes of color defects not according to standard, especially operators who paid less attention to the condition of mova and were less careful in adjusting the mova dye. The FMEA results showed the highest RPN value of 294 in the human aspect. The proposed improvements included increasing operator accuracy and discipline in operating mova, checking the condition of mova periodically, and ensuring that mova settings were in accordance with standards before and during the production process. By implementing these proposed improvements, it is expected that the number of defective products, especially color defects not according to standard, can be minimized and the quality of the bottle filo production process can be improved.

Keywords : Six Sigma, Quality, Defective Products, Filo Bottle, FMEA, Mova.

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Abstrak

Penelitian ini bertujuan untuk menganalisis dan mengidentifikasi penyebab kegagalan yang dominan pada proses produksi *bottle filo* di PT. Cahaya Perdana Plastik serta memberikan usulan perbaikan untuk mengurangi jumlah produk cacat. Metode yang digunakan dalam penelitian ini adalah *Six Sigma* dengan tahapan DMAI (*Define, Measure, Analyze,* dan *Improve*). Data yang digunakan merupakan data produk cacat pada periode 1 Oktober sampai 31 November 2020 pada bagian *Injection*. Alat analisis yang digunakan meliputi *P-Chart*, *Pareto Chart*, *Cause and Effect Diagram* (*Fishbone*), dan FMEA (*Failure Mode and Effect Analysis*). Hasil penelitian menunjukkan bahwa dari total produksi sebanyak 73.552 *bottle filo* terdapat 6.819 produk cacat. Jenis cacat yang paling dominan adalah *warna tidak sesuai dengan standar* sebanyak 3.720 unit, diikuti cacat *tipis* sebanyak 2.204 unit, *silvermark* sebanyak 515 unit, dan *gelembung* sebanyak 380 unit. Berdasarkan hasil pengukuran diperoleh nilai DPMO sebesar 425.460,64 dengan tingkat sigma sebesar 5,41. Hasil analisis *Cause and Effect Diagram* menunjukkan bahwa faktor manusia merupakan salah satu penyebab utama terjadinya cacat warna tidak sesuai standar, khususnya operator yang kurang memperhatikan kondisi *mova* dan kurang teliti dalam melakukan penyetelan *mova* pewarna. Hasil FMEA menunjukkan nilai RPN tertinggi sebesar 294 pada aspek manusia. Usulan perbaikan yang diberikan meliputi peningkatan ketelitian dan kedisiplinan operator dalam mengoperasikan *mova*, pemeriksaan kondisi *mova* secara berkala, serta memastikan pengaturan *mova* telah sesuai dengan standar sebelum dan selama proses produksi. Dengan penerapan usulan perbaikan tersebut, diharapkan jumlah produk cacat, khususnya cacat warna tidak sesuai standar, dapat diminimalkan dan kualitas proses produksi *bottle filo* dapat ditingkatkan.

Kata Kunci : *Six Sigma*, Kualitas, Produk Cacat, *Bottle Filo*, FMEA, *Mova*.

1. INTRODUCTION

Quality improvement is a crucial aspect that companies must consider to maintain their existence and competitiveness in an increasingly competitive business world. Industrial competition not only demands companies increase production volume and generate profits, but also produce products that meet consumer needs and satisfaction. A company's ability to deliver quality products that meet consumer expectations will impact its sustainability in the face of competition. Therefore, quality is a crucial factor that needs to be considered in production activities (Ciptani, 1999).

In the manufacturing industry, a company's competitive advantage can be seen, among other things, in the quality of its products. Continuous quality improvement is necessary to create an effective and efficient production process and minimize failures. Quality control is implemented to ensure that products meet established standards and specifications. One approach that can be used to improve quality is the Six Sigma method. The Six Sigma method can be used to identify sources of variation and failure in processes, reduce defects, and increase process capability through systematic and continuous improvement. The Six Sigma principle is customer-oriented, involves all elements of the company, and emphasizes continuous improvement and learning with the goal of achieving high-sigma process capability and approaching zero defects (Evan and Lindsay, 2007).

PT. Cahaya Perdana Plastik (CPP) is a manufacturing company that produces various plastic household products under the "Lion Star" brand. In its production activities, the company carries out various stages, from raw material processing to finished products. To maintain product quality and meet predetermined specifications, the company needs to ensure that each stage of the production process runs optimally. However, during implementation, defects were still found in the production process, particularly in the filo bottle section of the injection section. The presence of these defects can lead to an increase in the number of rejects and indicates that there are still factors in the production process that need improvement.

Based on production data from October 1 to November 31, 2020, out of a total production of 73,552 filo bottles, 6,819 were defective. The types of defects found included 3,720 units with color not meeting standards, 2,204 units with thinness, 515 units with silvermark, and 380 units with

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bubbles. The data indicates that color not meeting standards is the most prevalent failure type. This situation requires further analysis to identify the factors contributing to the failure and determine appropriate corrective actions.

Quality issues in the filo bottle production process need to be addressed systematically so the company can reduce the number of defects and improve the quality of the production process. Therefore, this study used the Six Sigma method with the Define, Measure, Analyze, and Improve (DMAI) stages. These stages are used to identify the dominant types of defects, measure process performance, analyze the factors causing the defects, and develop improvement proposals. Several quality control tools were used in the analysis process, including the P-Chart, Pareto Chart, Cause and Effect Diagram (Fishbone), and Failure Mode and Effect Analysis (FMEA).

Based on this description, this study aims to identify the most dominant failures in the filo bottle production process, identify and analyze the factors causing these failures, and propose improvements to reduce the number of defective products. The research results are expected to provide input for PT. Cahaya Perdana Plastik in improving the quality of its production process and minimizing rejects in filo bottle products.

2. RESEARCH METHOD

This research was conducted at PT. Cahaya Perdana Plastik (CPP), located at Jl. Kapuk Kamal Raya No. 09, RT 3/RW 3, Kamal Muara, Penjaringan District, North Jakarta City, Special Capital Region of Jakarta. The research focused on the filo bottle production process in the injection section. The data used were production data and product failure data for the period from October 1 to November 31, 2020.

Data collection was conducted using primary and secondary data. Primary data was obtained through direct observation of the production process and interviews with company officials and operators involved in the production process to obtain information on the factors causing failures. Secondary data was obtained from company documentation, including a general description of the company, the filo bottle production process, production volume, the number of defective products, and the types of failures that occurred during the research period.

The analysis method used was Six Sigma with the DMAI (Define, Measure, Analyze, and Improve) approach. In the Define stage, problems are identified and observation objects are determined using the 5W+1H approach. The Measure stage is conducted by processing failure data through data adequacy testing, creating a P-Chart, calculating Defects per Million Opportunities (DPMO), and determining the sigma level. Next, the Analyze stage is conducted to identify the dominant failure types using a Pareto Chart and analyze the causal factors using a Cause and Effect Diagram (Fishbone). In the Improve stage, improvement proposals are developed based on the results of the Failure Mode and Effect Analysis (FMEA) analysis, taking into account the Risk Priority Number (RPN) values for each failure factor.

The results of all analysis stages are used as the basis for determining improvement proposals to reduce product defects in the *filo bottle* production process. Furthermore, conclusions are drawn up based on the research objectives and analysis results, while recommendations are provided for the company to consider in improving the quality of its production process.

3. RESULT AND DISCUSSION

Define Stage Analysis

Define is the first operational step in a Six Sigma quality improvement program. Data processing revealed that PT Cahaya Perdana Plastik still produced defective products, including 3,720 non-standard colors, 2,204 thin products, 515 silvermarks, and 380 bubbles, resulting in a total of 6,819 defective products out of a total production of 73,552 filo bottles.

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Measure Stage Analysis

Based on the data processing performed in the previous chapter, the p control chart can be seen in Figure 1 below:

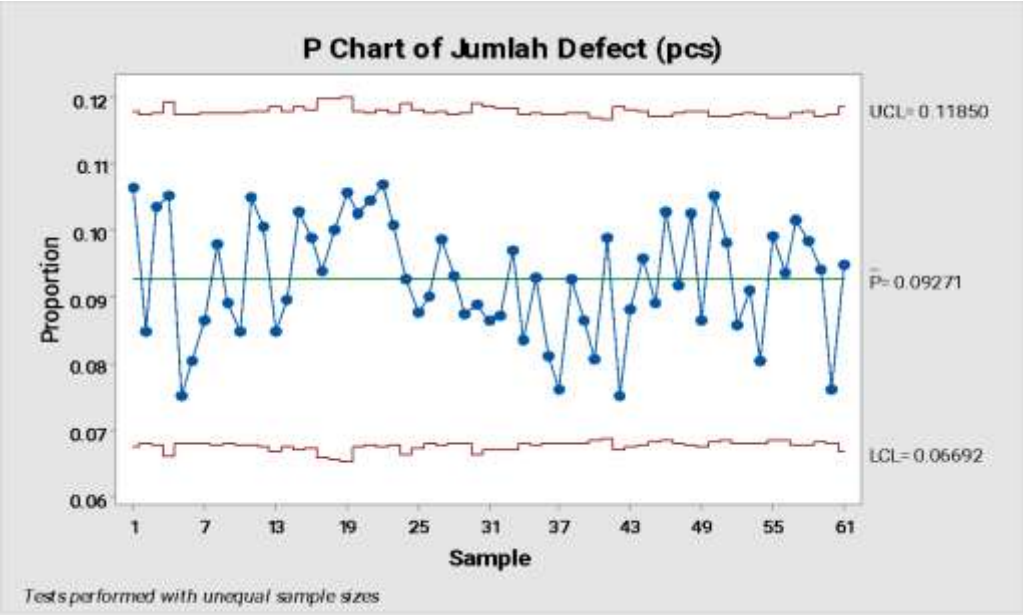


Figure 1 P bottle filo Control Chart

(Source: Processed Data)

Judging from the results of the calculations and Minitab above, it shows that the Filo bottle production process is still in good condition in statistical calculations and the results of the Minitab software on the p-Chart graph can be seen that the calculations show that all data is within the control limits.

Analisa Nilai DPMO Dan *Level Sigma*

In the filo bottle production process, the chance of defects occurring DPO is 0.425460637, which means that the chance of defects occurring per million DPOM opportunities in the filo bottle production process is 425460.6365, and after being converted into a six sigma value, the value is 5.41. Based on the table of achievement of the six sigma level, it shows that the process is not good because there are still defects produced so that it is still necessary to improve the quality of the process even though the achievement of the six sigma value is already at the industry average.5.3 Analisis Tahapan Analyze

Based on the previously conducted data processing, it was determined that PT. Cahaya Perdana Plastikn had the highest failure rate, namely 1 failure per million opportunities, with a sigma level of 5.41.

Cause and Effect Diagram Analysis

This diagram aims to identify the consequences of a problem that has occurred so that corrective action can be taken. Several factors contribute to substandard color defects in filo bottles, including:

- Human factors Not paying attention to MOVA and lack of discipline
- Machine factors Inappropriate settings
- Raw material factors Uneven mixing of materials and colors
- Method factors No unstable MOVA setting book

Improvement Stage Analysis

The improvement stage is the stage of improvement carried out and provides solutions to problems that cause defects in bottle fil products. Based on the results obtained, the necessary improvements are from the operator's perspective, as this is due to inaccurate work in the filo bottle production process, which leads to color failures that do not meet standards. Meanwhile, the control

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stage requires strict supervision from the company to minimize the occurrence of defective products. Based on the FMEA analysis results, the human aspect needs to be improved, as it has the highest RPN value of 294. Meanwhile, the control phase requires strict supervision from the company to minimize the occurrence of defective products.

4. CONCLUSION

Based on the results and discussion, the following conclusions can be drawn:

The dominant failure in the Filo bottle production process is the non-standard color defect, totaling 3,720 units. The primary cause of this dominant failure is the human factor, specifically the operators' failure to monitor the mova unit for Filo bottle coloring and a lack of discipline, where operators are not meticulous enough when calibrating the colorant mova. The human factor is the most dominant cause of failure. The specific reasons why color non-conformity occurs due to human factors are as follows :

- Bullet Inattention to the mova

Operators fail to monitor the mova unit, causing unstable color production. This typically happens when the mova monitor displays "LEARN" instead of "OK," indicating that the system is still searching for the correct color dosage to feed through the color funnel. When the screen displays "LEARN," the resulting Filo bottles are usually off-spec or even clear/translucent because the funnel fails to draw the colorant. Conversely, if the machine produces a color darker than the standard, it is typically because the mova monitor settings are set too high

- Bullet Lack of discipline

Operators lack precision when adjusting the colorant mova. Whenever the shade is too light or too dark, operators must immediately check the mova monitor. However, they are often careless during calibration. For example, if the color is too light, the mova must be adjusted immediately by slightly increasing the mova temperature percentage—such as raising it from an initial 1.25% to 1.28%. Conversely, if the resulting color is darker than standard, the mova temperature percentage must be decreased accordingly.

Proposed corrective actions to reduce the dominant defect in Filo bottles caused by human factors are:

- Bullet Inattention to the mova

To minimize defects, operators must pay closer attention to the mova unit. A routine check should be established approximately every 5 minutes to ensure the color mova operates strictly according to specifications.

- Bullet Lack of discipline

To reduce errors, operators must exercise greater precision when calibrating the mova, specifically by verifying and confirming whether the adjusted settings comply with the standard before resuming production.

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