



Quality Control of Plastic Pallet Products Using the Taguchi Method to Reduce Product Rejection: A Case Study on the Sound 1800 Machine

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Abstract: PT Group Cemerlang Plastindo continues to experience product rejection in the plastic pallet production process using the Sound 1800 injection molding machine. This condition reduces product quality, increases material waste, and decreases production efficiency, indicating the need for effective quality control and process parameter optimization. **Objective:** This study aims to identify the dominant types of product rejection, analyze the factors causing product defects, and determine the optimal combination of process parameters to reduce the reject rate of plastic pallet products. **Methods:** This study employed a quantitative approach using the Taguchi method supported by Statistical Quality Control (SQC) tools, including check sheets, histograms, Pareto diagrams, control charts, and fishbone diagrams. Data were collected from production records between January 2025 and January 2026, direct observations, and interviews with production personnel. **Results:** The results showed that 2,499 products were rejected from a total production of 107,669 plastic pallets. The dominant defects were short shot (998 units), uneven coloring (708 units), and crack (505 units). The application of the Taguchi method reduced the number of rejected products from 383 units to 332 units, corresponding to a 0.39% reduction in the reject ratio, indicating that process parameter optimization improved production quality. **Implications:** The findings demonstrate that integrating Statistical Quality Control tools with the Taguchi method provides an effective approach for identifying dominant defects, determining optimal process parameters, reducing production waste, and improving product quality consistency. The recommended parameter settings can serve as a practical reference for quality improvement in industrial injection molding operations. **Originality:** The originality of this study lies in the integration of Statistical Quality Control tools and the Taguchi method to optimize process parameters for plastic pallet production on the Sound 1800 injection molding machine using actual industrial production data. This integrated approach provides a practical quality improvement strategy for reducing the three dominant rejection types under real manufacturing conditions.

Keywords: fishbone diagram; injection molding; plastic pallet; quality control; Taguchi method.

INTRODUCTION

The manufacturing industry is required to produce high-quality products while maintaining production efficiency and minimizing waste. Product quality is an important factor because it directly affects customer satisfaction, production cost, company

competitiveness, and business sustainability. In plastic manufacturing, especially in injection molding processes, product defects remain a common problem because they can increase material loss, rework activities, machine downtime, and production inefficiency. Chaciński and Sutowski explained that defects in plastic injection molding are often influenced by process parameters, material characteristics, mold conditions, and machine stability ([Chaciński & Sutowski, 2021](#)). Therefore, quality control is needed not only to inspect the final product but also to control the production process so that the number of rejected products can be reduced.

Plastic pallets are products that require consistent quality because they are widely used in logistics, warehousing, food distribution, pharmaceutical industries, and export packaging. These products must meet quality standards related to dimension, weight, strength, surface condition, and visual appearance. PT. Group Cemerlang Plastindo is a plastic pallet manufacturing company that uses the Sound 1800 machine in its production process. Based on production data from January 2025 to January 2026, the rejection rate of plastic pallet products fluctuated between 1.68% and 2.95%, and several periods exceeded the company tolerance limit of 2%. The dominant defects were short shot, uneven coloring, and crack. This condition indicates that the production process has not yet reached stable operating conditions and still requires improvement through process parameter optimization.

Several previous studies have discussed quality control in manufacturing using Statistical Quality Control (SQC) and Seven Tools ([Hairiyah et al., 2019](#); [Nazia et al., 2023](#)). Lestari and Purwatmini showed that quality control methods can be used to identify defect patterns and support improvement activities in production processes ([Lestari & Purwatmini, 2021](#)). Aunillah and Himawan also stated that Seven Tools are useful for classifying defect types and determining priority problems through tools such as check sheets, histograms, Pareto diagrams, control charts, and fishbone diagrams ([Aunillah & Himawan, 2022](#)). In addition, Nazia emphasized that SQC plays an important role in monitoring process stability and supporting continuous improvement ([Nazia & Fuad, 2023](#)). However, SQC and Seven Tools generally function as diagnostic tools. These methods can identify what types of defects occur and what factors may cause them, but they do not directly determine the optimal combination of production process parameters.

Other studies have applied the Taguchi method to improve product quality and reduce process variation ([Rachman et al., 2019](#)). Hamzaçebi explained that the Taguchi method is a

robust design approach that uses orthogonal arrays to reduce the number of experiments while still allowing systematic analysis of several control factors ([Hamzaçebi, 2020](#)). In the injection molding process, Moayyedian applied the Taguchi method to optimize process parameters for polypropylene components ([Moayyedian et al., 2021](#)). Pradana and Sulistiyowati also found that the Taguchi method can support quality improvement by using signal-to-noise ratio analysis to determine the best parameter settings ([Pradana & Sulistiyowati, 2022](#)). These studies show that the Taguchi method is relevant for optimizing manufacturing processes. However, the optimal parameters obtained from previous studies cannot be directly generalized because injection molding quality is influenced by product geometry, material type, machine capacity, mold condition, and actual production environment.

Previous studies have also attempted to combine quality control tools with optimization methods. Maulidia used the Taguchi method to analyze quality improvement in rubber seal production ([Maulidia et al., 2020](#)). Intan and Supriyadi discussed the use of Taguchi in product quality improvement and quality design ([Intan & Supriyadi, 2024](#)). Ramadhan and Bisono also applied Taguchi for injection molding parameter optimization ([Ramadhan & Bisono, 2024](#)). Nevertheless, studies focusing on plastic pallet products using actual industrial data and large-capacity injection molding machines are still limited. Most previous studies focused on smaller plastic components, general manufacturing products, or laboratory-scale experiments. Therefore, there is still a research gap in applying an integrated SQC and Taguchi approach to reduce dominant rejection types in plastic pallet production, particularly on the Sound 1800 machine.

Based on this gap, this study aims to determine the optimal combination of machine temperature, pressing time, and cooling time to reduce the rejection rate of plastic pallet products on the Sound 1800 machine at PT. Group Cemerlang Plastindo. This study integrates SQC tools, including check sheets, histograms, Pareto diagrams, fishbone diagrams, and control charts, with the Taguchi method. The SQC tools are used to identify dominant defects and analyze their possible causes, while the Taguchi method is used to determine the optimal process parameter settings. The contribution of this study is to provide a practical and data-based quality control recommendation for reducing short shot, uneven coloring, and crack defects in plastic pallet production.

This study argues that product rejection in plastic pallet manufacturing is influenced by the instability of key injection molding process parameters, especially machine

temperature, pressing time, and cooling time. Machine temperature is expected to affect material melting and color distribution. Pressing time is expected to influence mold filling and product compactness. Cooling time is expected to affect crack formation and dimensional stability. Therefore, the application of the Taguchi method supported by SQC tools is expected to identify the most influential process factors and produce an optimal parameter combination that can reduce the rejection rate compared with the existing production condition.

RESEARCH METHOD

This study was conducted at PT. Group Cemerlang Plastindo, located in Tanggulangin, Sidoarjo, with a research focus on quality control of plastic pallet products on the Sound 1800 machine using the Taguchi method. The Taguchi method was used as a quality control approach to determine the optimal combination of process parameters in order to minimize the rate of rejected products and improve the stability of the production process. This approach was selected because it is capable of producing process parameters that are robust against disturbance factors and is more efficient in experimental implementation.

The initial stage of the study was carried out through direct observation in the plastic pallet production area to understand the production process flow and identify quality problems that occurred during the production process. Observations were conducted on machine conditions, production process parameters, and types of product defects that frequently occurred. In addition, a literature review was conducted through journals, books, and previous studies related to quality control, the seven tools, and the Taguchi method as the theoretical basis of the study.

Data collection in this study consisted of primary and secondary data. Primary data were obtained through direct observation, interviews with operators and the production manager, and records of the number of rejected products on the Sound 1800 machine from January 2025 to January 2026. The data collected included production volume, number of rejected products, types of product defects, and production process parameters such as machine temperature, pressing time, and cooling time. Meanwhile, secondary data were obtained from company documents, production reports, company quality standards, and supporting references from journals and scientific books.

The data processing technique in this study was carried out through several stages, as follows:

1. Determination of Product Rejection Factors

By collecting check sheet forms, preparing histograms, Pareto diagrams, and control charts using the company’s product rejection data, PT. Group Cemerlang Plastindo was able to identify the variables used in determining parameter settings. To adjust these variables to the existing conditions at PT. Group Cemerlang Plastindo, interviews or question-and-answer sessions were also conducted with the quality control department, in addition to reviewing previous studies.

Table 1. Check Sheet Form

No	Month	Production Quantity (pcs)	Defect Type			Total Defects (pcs)
			Short shot	Uneven Coloring	Crack	

2. Development of a Cause-and-Effect Diagram

A cause-and-effect diagram consisting of five categories, namely human, material, method, machine, and environment, was developed after the variables had been determined. The purpose of developing the cause-and-effect diagram was to simplify the problem and facilitate the calculation process for parameter determination.

3. Experiment Using the Taguchi Method

a. Determination of the Dependent Variable

The dependent variables in this study include uneven coloring and short shots at PT. Group Cemerlang Plastindo. The criterion used is “smaller the better,” which means that reducing the number of defective products will improve quality.

b. Identification of Factors (Independent Variables)

This study uses machine temperature, molding time, and cooling time as independent variables. In this experiment, machine temperature, pressing time, and cooling time are isolated as control parameters. Weather conditions and room temperature are considered noise factors.

c. Determination of the Number of Levels and Factor Level Values

Three experimental levels were used for the following variables in this study:

Table 2. Design of Factor Values at Levels 1 to 3

No.	Notation	Factor	Level 1	Level 2	Level 3
1	A	Production machine temperature	180°	200°	220°
2	B	Pressing time	20 seconds	35 seconds	50 seconds

3	C	Cooling time	1 minute	1.5 minutes	2.5 minutes
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4. Calculation of Degrees of Freedom

The minimum number of experiments required to test the observable variables was calculated using degrees of freedom.

$$\text{Dof} = nA - 1 \tag{1}$$

5. Selection of the Orthogonal Array

An equation describing the number of elements, levels, and observations conducted is required to select the appropriate orthogonal array.

$$\text{Derajat bebas matriks} = \text{jumlah faktor} \times (\text{jumlah level} - 1) \tag{2}$$

6. Preparation for Experimental Implementation

Determining the number of replications and designing a randomized experimental design are two aspects involved in experimental preparation.

7. Data Analysis

Data processing includes data collection, calculation, and presentation. In addition, formulas were applied to the experimental data to perform data calculations and evaluation. The signal-to-noise (S/N) ratio approach and the calculation of main effects were used in data processing.

$$S/N = -10 \log \frac{1}{N} \sum_{i=1}^q \sum_{j=1}^j \sum_{k=1}^N (y_{ijk})^2 \tag{3}$$

8. Analysis of Variance (ANOVA)

Analysis of variance is a technique used to determine the number of degrees of freedom in an experiment by decomposing variance into different sources of variation. The calculated data include the overall experimental mean, total sum of squares, mean sum of squares, sum of squares for each factor level, degrees of freedom, mean square, error sum of squares, factor pooling, F-ratio, pure sum of squares, and percentage contribution.

9. Confirmation Experiment

The confirmation experiment includes the results obtained from the previous data analysis. The purpose of this experiment is to identify the ideal parameter settings.

RESULT

This study aims to analyze the causes of rejected products in the plastic pallet production process at PT. Group Cemerlang Plastindo using the Taguchi method. This method is used to identify the factors that affect product quality and to determine the optimal combination of process parameters for reducing the rejection rate on the Sound 1800 machine. The following presents the results and discussion for each stage of the study.

Identification of Product Rejection Data

The initial stage of the study was conducted by identifying the number of rejected plastic pallet products on the Sound 1800 machine from January 2025 to January 2026. Rejection data were obtained from the company’s production records, which showed that the rejection rate still fluctuated and several times exceeded the company’s tolerance limit of 2%.

Table 3. Rejection Percentage of the Sound 1800 Machine

Month	Production Quantity (pcs)	Rejected Products (pcs)	Rejection Percentage
January 2025	8,089	239	2.95%
February 2025	7,855	215	2.74%
March 2025	8,275	210	2.53%
April 2025	8,230	207	2.52%
May 2025	8,229	212	2.58%
June 2025	8,305	193	2.32%
July 2025	8,570	207	2.42%
August 2025	8,709	211	2.42%
September 2025	8,997	198	2.20%
October 2025	9,075	175	1.93%
November 2025	9,093	163	1.79%
December 2025	8,849	149	1.68%
January 2026	5,393	121	2.24%

Based on Table 3, the highest rejection percentage occurred in January 2025, at 2.95%, while the lowest rejection percentage occurred in December 2025, at 1.68%. However, in January 2026, the rejection percentage increased again to 2.24%. This indicates that the plastic pallet production process on the Sound 1800 machine remains unstable and is influenced by variations in production process parameters as well as work environment factors.

Analysis of Product Rejection Types

The next stage involved identifying the most dominant types of rejection in the plastic pallet production process. The data indicate that several types of rejection occurred during production, namely short shots, uneven coloring, cracks, dimensional errors, over/underweight, warping, and overflow.

Table 4. Total Rejection Types on the Sound 1800 Machine

Rejection Type	Total Rejections (pcs)
Short shot	998
Uneven coloring	708
Crack	505
Dimensional error	59
Over/Underweight	34
Warping	77
Overflow	118

Based on Table 4, short shot was the most dominant type of defect, with a total of 998 pcs, followed by uneven coloring with 708 pcs and cracks with 505 pcs. These three types of rejection were the largest contributors to the total production failures of plastic pallets on the Sound 1800 machine.

Short shot defects occur when molten plastic material does not completely fill the mold cavity. Uneven coloring is caused by non-uniform color distribution during the material mixing and heating process, whereas crack defects occur due to an unstable cooling process, which causes cracks to form in the pallets.

Fishbone Diagram Analysis

The analysis stage was conducted using a fishbone diagram to identify the main factors causing rejected plastic pallet products. The results of the analysis show that the causes of product rejection originate from human, machine, method, material, and environmental factors.

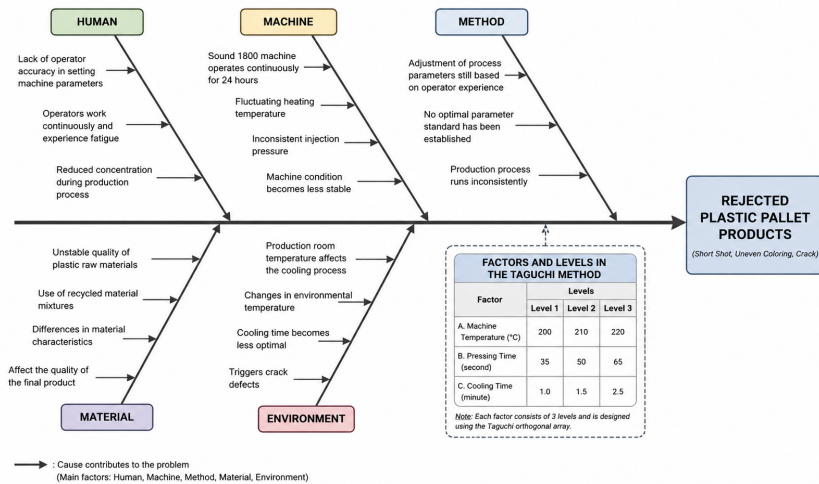


Figure 1. Fishbone Diagram

1) Human

The lack of operator accuracy in setting machine parameters is one of the causes of product rejection. In addition, operators who work continuously experience increased fatigue, which affects their concentration during the production process.

2) Machine

The Sound 1800 machine, which operates continuously for 24 hours, causes the machine condition to become less stable. Fluctuating heating temperatures and inconsistent injection pressure lead to the occurrence of short shot and uneven coloring defects.

3) Method

The adjustment of production process parameters is still based on operator experience; therefore, no truly optimal parameter standard has been established. This condition causes the production process to operate inconsistently.

4) Material

The unstable quality of plastic raw materials affects the quality of the plastic pallets produced. The use of recycled material mixtures also causes differences in material characteristics, thereby influencing the quality of the final product.

5) Environment

The production room temperature and work environment conditions affect the stability of the product cooling process. Changes in environmental temperature cause the cooling time to become less optimal and trigger the occurrence of crack defects.

6) Determination of Factors and Levels in the Taguchi Method

Based on the identification of the problems, this study used three main factors in the Taguchi method experiment, namely production machine temperature, pressing time, and cooling time. Each factor consisted of three experimental levels.

Table 5. Experimental Factors and Levels

Factor	Level 1	Level 2	Level 3
Production machine temperature	180°C	200°C	220°C
Pressing time	20 seconds	35 seconds	50 seconds
Cooling time	1 minute	1.5 minutes	2.5 minutes

The determination of factor levels was based on the actual conditions of the production process on the Sound 1800 machine and the results of discussions with operators and the company’s quality control department.

Analysis Using Statistical Tools

Based on the calculation results using statistical tools at the check sheet stage, historical data on plastic pallet production for 13 months at PT. Group Cemerlang Plastindo were obtained. The total production of plastic pallets reached 107,669 pcs, with a total of 2,499 rejected products. The types of rejection identified included 998 pcs of short shots, 708 pcs of uneven coloring, 505 pcs of cracks, 59 pcs of dimensional errors, 34 pcs of over/underweight products, 77 pcs of warping, and 118 pcs of overflow.

Table 6. Types of Rejected Plastic Pallet Products

No.	Type of Rejection	Number of Rejections	Rejection Percentage
1	Short shot	998	39.94%
2	Uneven coloring	708	28.33%
3	Crack	505	20.21%

Based on Table 6, short shot, uneven coloring, and crack were the three most dominant types of rejection in plastic pallet production at PT. Group Cemerlang Plastindo. Short shot had the highest percentage, at 39.94%, followed by uneven coloring at 28.33% and crack at 20.21%.

The histogram and Pareto diagram results indicate that these three types of rejection should be prioritized in product quality improvement because they contributed the most to the total number of product defects.

The next stage was conducted using a control chart to determine the stability of the production process. Based on the control chart calculation results, the rejection data

remained within the control limits. This indicates that the production process was still within reasonable control limits; however, the company still needs to improve product quality in order to reduce the rejection percentage as much as possible.

Signal-to-Noise Ratio (S/N Ratio) Analysis

The next stage involved processing the experimental data using the signal-to-noise ratio (S/N ratio) approach with the “smaller-the-better” quality characteristic. This approach was used because the objective of the study was to minimize the number of rejected products.

The analysis results show that production machine temperature had the greatest influence on the quality of plastic pallets. A machine temperature that was too low caused the material to melt incompletely, resulting in short shot defects. Conversely, an excessively high temperature caused product discoloration and triggered uneven coloring defects.

In addition to machine temperature, cooling time also had a significant effect on the occurrence of crack defects. A cooling time that was too short caused the product to crack due to unstable temperature changes. Therefore, an optimal combination of parameters is required so that the production process can operate more stably and produce better product quality.

Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) was conducted to determine the factors that had the greatest influence on the quality of plastic pallet products. The analysis results show that production machine temperature was the dominant factor affecting the product rejection rate, followed by pressing time and cooling time.

Based on the results of the Taguchi method calculations, the optimal parameter combination was obtained at a production machine temperature of 200°C, a pressing time of 35 seconds, and a cooling time of 1.5 minutes. This parameter combination was able to produce a more stable production process and reduce the number of rejected products compared with the previous condition.

Taguchi Method Analysis

The Taguchi method was used to determine the effects of factors and process parameter levels on the quality of plastic pallets. The quality characteristic used was

“smaller the better” because this study aimed to reduce the number of rejected products to the lowest possible level.

Table 7. Results of the Taguchi Method Application

Rejection Type	Predicted Experiment	Confirmation Experiment
Short shot	142 pcs	120 pcs
Uneven coloring	124 pcs	113 pcs
Crack	117 pcs	99 pcs
Total	383 pcs	332 pcs

The total production of plastic pallets during the study was 13,020 pcs, obtained from a production output of 930 pcs per day over 14 working days. Based on the Taguchi experiment results, the predicted number of rejected products was 383 pcs, or:

$$\frac{383}{13.020} \times 100\% = 2,94\%$$

After machine parameter optimization was conducted through the confirmation experiment, the number of rejected products decreased to 332 pcs, or:

$$\frac{332}{13.020} \times 100\% = 2,55\%$$

These results indicate that process parameter optimization using the Taguchi method successfully reduced the rejection rate by 0.39%.

Optimal Parameter Settings

The following optimal parameter settings were obtained from the confirmation experiment.

Table 8. Optimal Parameter Settings for Short Shot

Factor	Level	Optimum Level Value
Temperature parameter setting (A)	2	200°C
Pressing time (B)	3	50 seconds
Cooling time (C)	1	1 minute

Table 9. Optimal Parameter Settings for Uneven Coloring

Factor	Level	Optimum Level Value
Temperature parameter setting (A)	3	220°C
Pressing time (B)	3	50 seconds
Cooling time (C)	2	1.5 minutes

Table 10. Optimal Parameter Settings for Crack

Factor	Level	Optimum Level Value
Temperature parameter setting (A)	3	220°C

Pressing time (B)	2	35 seconds
Cooling time (C)	3	2.5 minutes

Based on the results of the Taguchi experiment, production machine temperature was found to be the most influential factor affecting the quality of plastic pallets. A machine temperature that was too low caused the material to melt incompletely, resulting in short shot defects. Conversely, an excessively high temperature could cause product discoloration and trigger uneven coloring defects.

In addition to machine temperature, cooling time also had a significant effect on the occurrence of crack defects. A cooling time that was too short caused the product to crack due to unstable temperature changes. Therefore, an optimal combination of parameters is required so that the production process can operate more stably and produce better product quality.

Confirmation Experiment

The final stage was the confirmation experiment, which was conducted to verify the optimal parameter combination obtained from the Taguchi method. The experimental results showed that the optimal parameter combination was able to significantly reduce the product rejection rate, particularly for short shot, uneven coloring, and crack defects.

The application of the optimal parameters also improved the stability of the production process and produced plastic pallets with more consistent quality in accordance with company standards. Therefore, the Taguchi method was proven to be effective as a quality control method for reducing the rejection rate of plastic pallet products on the Sound 1800 machine at PT. Group Cemerlang Plastindo.

DISCUSSION

The results of this study demonstrate that the quality performance of plastic pallet production on the Sound 1800 injection molding machine has not yet achieved stable operating conditions. During the observation period, the rejection rate fluctuated between 1.68% and 2.95%, with several production periods exceeding the company's tolerance limit of 2%. Among the identified defects, short shot, uneven coloring, and crack represented the largest proportion of rejected products. After applying Statistical Quality Control (SQC) and the Taguchi method, the optimal combination of production parameters was successfully identified, reducing the rejection rate from 2.94% to 2.55%. These findings

indicate that systematic parameter optimization can effectively improve production quality and process consistency.

The dominance of short shot defects indicates that molten polymer was unable to completely fill the mold cavity during injection molding. This condition is commonly associated with insufficient melt temperature, inadequate packing pressure, or inappropriate filling time. Likewise, uneven coloring reflects non-uniform pigment dispersion caused by unstable melting conditions and inconsistent material flow during injection. Crack defects mainly occurred because the cooling stage did not provide sufficient time for uniform solidification, leading to residual thermal stress inside the product. These findings confirm that machine temperature, pressing time, and cooling time are strongly interconnected, and improper adjustment of one parameter may influence the effectiveness of the other parameters during the molding cycle.

The present findings are consistent with previous studies reporting that process parameter optimization significantly improves injection molding quality. Hamzaçebi (2020) explained that the Taguchi method is effective in identifying robust operating conditions while minimizing process variation through orthogonal array experimentation. Similarly, Moayyedian demonstrated that optimization of melt temperature and cooling conditions significantly reduced dimensional defects in polypropylene injection molding ([Moayyedian et al., 2021](#)). Fadlillah also reported that nozzle temperature and holding pressure substantially influence flash formation in polypropylene products ([Fadlillah & Hardjito, 2025](#)). Unlike previous studies that mainly focused on laboratory-scale specimens or relatively small plastic components, this study applies the Taguchi method to an actual industrial production line manufacturing plastic pallets using a large-capacity Sound 1800 injection molding machine. Therefore, the present study extends previous knowledge by providing practical evidence that process parameter optimization remains effective under real manufacturing conditions characterized by continuous production, production variability, and industrial operating constraints.

Another important finding is that the integration of Statistical Quality Control tools and the Taguchi method provides a more comprehensive quality improvement strategy than using either approach independently. Seven Tools successfully identified the dominant rejection types and their possible root causes through historical production data, while the Taguchi method determined the optimal combination of controllable process parameters. Previous studies by Maulidia and Intan and Supriyadi also suggested that combining

quality analysis with process optimization provides more effective quality improvement than relying solely on inspection activities ([Intan & Supriyadi, 2024](#); [Maulidia et al., 2020](#)). The present study supports these findings by demonstrating that statistical monitoring alone cannot reduce defects unless followed by parameter optimization based on experimental analysis.

From an industrial perspective, the findings indicate that machine temperature is the most influential factor affecting product quality. Proper temperature control ensures complete melting of polymer materials, improves mold filling capability, and enhances color distribution throughout the product. Meanwhile, pressing time contributes to maintaining sufficient packing pressure, whereas cooling time controls product solidification and dimensional stability. These results emphasize that injection molding quality should be managed as an integrated process rather than through independent adjustment of individual parameters. Consequently, production engineers should consider simultaneous optimization of multiple process variables to achieve stable production performance.

The practical implications of this study are significant for manufacturing companies producing plastic pallets and similar injection-molded products. The recommended process parameters can be used as operational references for machine setup, standard operating procedures, and preventive quality control activities. The integration of Seven Tools and the Taguchi method may also support continuous improvement programs by reducing production waste, minimizing material consumption, lowering rejection costs, and improving overall manufacturing efficiency. Furthermore, these findings may assist quality engineers in establishing data-driven decision-making procedures for process optimization under industrial production environments.

Despite these contributions, several limitations should be acknowledged. This study was conducted using only one production machine, namely the Sound 1800 injection molding machine, and focused on three dominant defect categories. Other production variables, including injection pressure, holding pressure, screw speed, mold temperature, raw material composition, and environmental conditions, were treated as uncontrolled or noise factors. Consequently, the optimal parameter combination obtained in this study may not be directly applicable to other injection molding machines or different plastic products. Future research is therefore recommended to investigate additional control factors, apply response surface methodology or machine learning optimization techniques, and compare

multiple optimization methods to further improve process robustness and manufacturing quality.

CONCLUSION

This study concludes that the plastic pallet production process on the Sound 1800 machine at PT. Group Cemerlang Plastindo still requires quality improvement because the rejection rate fluctuated during the production period from January 2025 to January 2026. A total of 2,499 rejected products were identified from 107,669 plastic pallets produced. The most dominant defects were short shot, uneven coloring, and crack, indicating that the main quality problems were closely related to the stability of injection molding process parameters. The application of the Taguchi method showed that parameter optimization could reduce the number of rejected products from 383 pcs to 332 pcs, or decrease the rejection ratio by 0.39%.

The contribution of this study lies in the integration of Statistical Quality Control tools and the Taguchi method to support quality improvement in plastic pallet manufacturing. The study provides empirical evidence that machine temperature, pressing time, and cooling time are important parameters affecting product rejection. The recommended parameter settings can be used as a practical reference for improving production stability, reducing waste, and increasing the consistency of plastic pallet quality.

This study is limited to one production machine, namely the Sound 1800 machine, and focuses only on three dominant rejection types. Therefore, the findings cannot yet represent all machines, product variants, and production conditions at the company. Future studies are recommended to include additional process parameters such as injection pressure, holding pressure, mold temperature, screw speed, and material composition. Further research may also compare the Taguchi method with other optimization approaches to obtain more comprehensive quality control results.

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