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RECOMMENDATIONS FOR IMPROVEMENT AND CONTROL MECHANISMS IN THE PRODUCTION PROCESS OF NOXONE 297 SL 1 LITER WITH FMEA APPROACH

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ABSTRACT: Product packaging is one of the critical factors in a product. The main problem with product packaging is the frequent occurrence of defects that exceed the company's targets and cause consumer disappointment. The purpose of this research is to minimise the occurrence of defects in product packaging so that recommendations for improvement and performance control mechanisms are needed. Improvement recommendations are made based on analysing the failure mode using the Pareto chart and FMEA (failure mode and effect analysis) tools. The results of this study are in the form of SOP recommendations for improvement and control mechanisms for 3 product packaging.

Keywords: CTQ, FMEA, Pareto Chart

1. Introduction

The industrial world is incessantly discussing cost efficiency in the production process. One of the most influential efforts in increasing cost efficiency is to minimise the incidence of product defects and positively affect the minimum expenditure but produce a good quality product. A defective product is a unit of goods resulting from the production process and does not match the product specifications set by the company [1]. In general, the factors that cause defective products are directly related to the role of humans, methods, machines, materials, and the environment [2].

PT. Multi Sarana Indotani Mojokerto is an industry engaged in the pesticide sector. One of the flagship products of this company is the herbicide Noxone 297 SL 1liter. However, defects in the product packaging still exceed the company's limited target. Researchers obtained the information by conducting observations and discussions with the head of the production section. There are four defects in the product packaging (CTQ): charred seal defects, short bottle threads, leaking bottles, and dented bottle defects. From the problems that the company is facing, this research was carried out by applying the FMEA method and the Pareto chart, which aims to analyse priority failures and their causes, which are then used as the basis for preparing recommendations for improvement and control mechanisms—the control mechanisms for the implementation of improvements.

1.1 Definition and Concept of Quality

The quality of a product is the basis that can be measured whether the product is good or bad and will determine how consumers will give a reciprocal relationship. Quality problems in the business world must be a top priority so companies can survive. Companies must own seven dimensions of quality: performance, serviceability, reliability, durability, conformance, aesthetics, and features [3].

1.2 Definition and Concepts of Pareto Chart

Pareto diagrams in this study aim to determine what types of packaging defects are priorities for immediate repair [4]. The Pareto chart is a diagram that sorts the classification of numerical data from left to right based on the ranking order from highest to lowest. [5].

1.3 Definition and Concepts of FMEA

FMEA (failure mode and effect analysis) is a tool that can be used to help identify and eliminate various sources and causes of quality problems before entering the system, sub-system, product or production process [6].FMEA is one of the tools that can be used in conducting the analysis process of a production process, which is then carried out as an assessment of the risk at each stage of production, commonly called RPN (risk priority number) [7]. FMEA analysis has three reviews: severity, occurrence, and detection [8].

2. Research Methodology

This research begins by applying the observation method to the object of study in the field to see and know firsthand the general description of the production process of Noxone 297 SL 1liter. Then, together with the head of staff for production and quality control, the researchers conducted a discussion to reveal the CTQ of the production process. No less important, to support the smooth running of the research, the researcher conducts a literature study on previous studies and theories relevant to the research topic.

Next, the researcher analyses the problem on the object by applying the Pareto chart to determine what defects are the priority for repair. Then, an analysis is carried out using the FMEA method to find potential failures, the causes of the losses, and the company's actual control mechanisms, which are then used as the basis for the improvement process. Furthermore, an improvement scheme for the causes of process failures is prepared, which is a priority based on the RPN value to develop and implement it sustainably so that it can reduce the DPMO value and increase the sigma level [9]. Furthermore, the control process performance in the implementation of improvements is the manufacture of control mechanisms that are adapted to improve the recommendations

3. Results and Discussion

3.1 Define

Critical quality is a crucial characteristic directly related to the consumer's requirements for product and service specifications [11]. At the identification stage, researchers applied observation and discussion methods with production workers and quality control in the production process of the herbicide Noxone 297 SL 1liter so that four critical product packaging defects were obtained, including burnt seals, short bottle threads, leaky bottles and dented bottles.

3.2 Analysis Stage

In the early stages of the analysis, the researcher uses a Pareto chart to see what defects are priorities for deeper analysis using the FMEA approach.

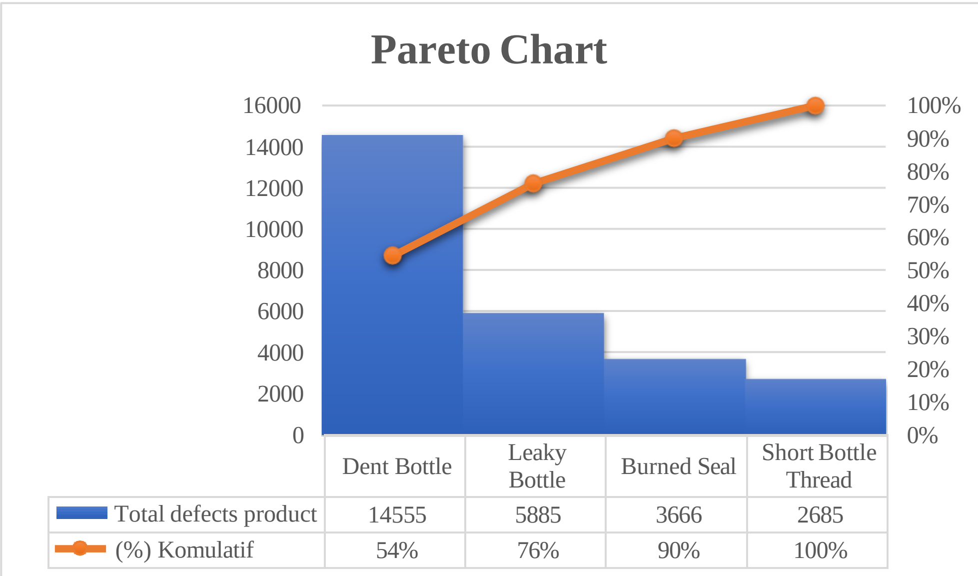

Figure 1 Priority CTQ

From the Pareto chart analysis above, the researchers prioritised three significant packaging types of defects: dented bottles, leaking bottles, and burnt seals. Furthermore, an investigation is carried out using the FMEA method to determine potential failures and the causes of possible shortcomings.

Table 1 FMEA of Packaging Defects of Herbicide Noxone 297 Sl 1liter

Potential Failure Mode	Potential Failure Effect	Severity	Potential Cause	Occurrence	Current Controls	Detection	S x O x D = RPN
Burned Seal	Seal can become too sticky and hot	6	The position of the induction seal is too close, and the temperature is high	4	Machine setup	5	120
Leaky Bottle	The nozzle presses the bottle body	6	The bottle position is not correct, and the conveyor is too fast	5	No bottle guard operator	6	180
Dent Bottle	Pressed bottle with high-pressure	7	The head capper is too short, and the capping pressure is too high	6	Machine setup	5	210
	Change the texture or shape of the bottle	4	There are finished products stored in the open	3	Visual check	7	84
	Products stacked incorrectly	3	Distributed products are not securely arranged	2	Visual check	7	42

3.3 Improvement Stage

At this stage, a repair scheme for the causesof failure is drawn up based on the four primary RPN values in Table 1 above. The repair scheme recommended by researchers can be seen in Table 2 .

Table 2 Improvement Actions

Failure of Mode	Cause of Failure	Suggestions for improvement
Dent Bottle	The head capper is too short, and the capping pressure is too high	Setting the height of the head capper (63-64 cm) from the turn table Setting capping pressure at a pressure of 0.4 Mpa Perform capper machine maintenance with a preventive model according to the factory default SOP.
	There are finished products stored in the open	Setting the warehouse layout as efficiently as possible Make accurate warehousing data management. Make predictions of optimal inventory requirements. Check the amount of inventory stock and calculate warehouse capacity.
Leaky Bottle	The bottle position is not correct, and the conveyor is too fast	Add an exceptional workforce controlling bottles on the conveyor Adjust conveyor speed with the nozzle. Make a cantering nozzle plate. Perform filler machine maintenance with a preventive model according to the factory default SOP.
Burned Seal	The position of the induction seal is too close, and the temperature is high.	Setting the induction seal at a height of 24.5 cm from the conveyor Induction seal temperature setting at level 40 C°- 42 C° Add seal detector machine. Perform maintenance on the induction seal machine according to the factory default SOP with a preventive model.

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3.4 Control System Mechanism

The control mechanism is made according to the proposed improvement scheme. This isintended to maintain the level of production performance after repairs are carried out so that it impacts continuous improvement. The control mechanism scheme can be seen in Table 3.

Table 3 Mechanism of Control System.

Process	Work instruction	Criteria	Control Tool	Control Period	Person responsible
Filling	Doing bottle monitoring	Bottles are neatly arranged on the conveyor	Manual	Every production process	Filler Operators
	Give the nozzle cantering plate	The nozzle drops right into the bottle hole	control panel	Before the filling process	Filler mechanic
	Maintenance of machines	Maintenance, according to the SOP from the factory, is preventive	Manual	Scheduled	Filler mechanic
Sealing	Setting the height of the induction seal according to repair standards	The induction seal is not too close to the bottle	control panel	Before the sealing process	sealer operator
	Induction seal temperature setting according to repair standard	The induction seal is not too hot	control panel	Before the sealing process	sealer operator
	Maintenance of machines	Maintenance, according to the SOP from the factory, is preventive	Manual	Scheduled	Mechanical sealer
Capping	Setting the height of the head capper according to repair standards.	The head capper is not too short and presses the bottle	control panel	Before the capping process	Capper operator
	Setting the capping pressure according to repair standards	Chuck does not rotate with too much pressure	control panel	Before the capping process	Capper operator
	Maintenance of machines	Maintenance, according to the SOP from the factory, is preventive	Manual	Scheduled	Capper mechanic

3.5 Implementation of Improvements

At this stage, the capability of the production process is remeasured after the recommendations for improvement and their control mechanisms have been implemented. This is aimed at knowing the extent to which suggestions for improvement can play a role in improving the performance of the production process. Table 4 below shows the gap in measuring process capability before and after implementing improvement recommendations.

Table 4 Process Capability After Repair

Measure	Before	After
Proportion of defects	0,01514	0,00410
DPMO	3785	1025
Sigma (σ)	4,2	4,7

4. Conclusions

The results of this study found the cause of process failure that resulted in defects in the Noxone 297 SL 1 litre package, namely the inability of the burnt seal was caused by the position of the induction seal being too close to the bottle cap and the temperature of the inductionseal above 42 C°, the bottle leaking due to the conveyor running too fast. This causes the nozzle to drop not right in the middle of the bottle so that it presses on the bottle body, and the bottle fails due to dents caused by three factors, including the head capper being too short, high-pressure capping pressure, and the finished product being stored in the open. The suggestions for improvements that researchers recommend include making measurement standards for the head capper height to be 63-64 cm from the conveyor, setting the pressure on the capping pressure at the level of 0.4 MPa, setting the temperature of the induction seal in the range of 40-42 C°, setting the height of the induction seal to be 24.5 cm from the conveyor, setting the conveyor speed according to the nozzle, and setting the warehouse layout as efficiently as possible and making accurate warehouse management.

References

[1] Siregar, Baldric, Suripto, and Bambang., 2013, *Cost accounting*, Selemba Empat, Jakarta

[2] Harianto, S., & Nursanti, E. 2020. Green quality improvement using the Six Sigma Method. International Journal of Innovative Science and Research Technology, 5(8), pp. 583-588.

[3] Prasastono, N. and Pradapa, S.Y., 2012, "Product quality and service quality on consumer satisfaction of Kentucky Fried Chicken Semarang Candi," *Tourism Dynamics*, pp. 13-23.

[4] Ariani, D. W. 2005. Statistical qualitycontrol (quantitative approach to quality management). Yogyakarta: C.V. Andi Offset.

[5] Ramadhani, G. S., Yuciana, & Suparti. 2014. Analysis of quality control using Demerit control chart (a case study of 240 ml bottled drinking water production at PT TIW). Gaussian Journal, 3(3), pp. 401-410.

[6] Rafsanjani, S., 2018, "Control and improve the quality of the product packaging printing process using the FMEA-TRIZ integration," *ITS Industrial Engineering Journal*, Surabaya.

[7] Liu, H.C., Liu, N. and Liu, L., 2013, "Risk Evaluation Approaches in Failure Mode and Effects Analysis," *Expert Systems with Applications*, pp. 828–838.

[8] Rachman, A., Adianto, H. and Linasari, G.P., 2016, "Improving the quality ofcement tile products using failure mode andeffect analysis and failure tree analysis in ceramic institutions," *National Institute of Technology Online Journal*, Bandung, pp. 24-35.

[9] Tri, A.W., Mustafid, and Parahutama, A., 2016, "The implementation of the Six Sigma method uses the ewma control chart as an effort to minimise the defects of green fabric products," *Gaussian Journal*, pp. 61-70.

[10] Husen, M., Gustopo, Dayal, & Laksmana, Dimas I., 2021. Product Quality Control Using Six Sigma (Dmaic) Methods To Minimize Wast In Bima Mandiri Cigarette Company Rembang, Pasuruan Regency. Journal of Sustainable Technology and Applied Science, 2(2), pp. 14-22.