# Implementation of The Six sigma Method in Controlling The Quality of The Cosmetic Cream Production Process at PT. XYZ

Joko Hardono [1*], Sri Lestari [(2),] , Rachmat Destriana [(3)] , Puji Rahayu[4] , Dede Muniarsih[5]

[1] Universitas Muhammadiyah Tangerang, Banten, 15810, Indonesia

[*] Corresponding author: jhardono69@gmail.com

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***Abstract:***

PT XYZ is a manufacturing company that produces medicines, cosmetics and food supplements. The frequent occurrence of cosmetic cream samples that do not meet the specifications set by the company has an impact on delays in the production schedule. The purpose of this paper is to identify the factors that cause cosmetic cream product defects, then provide suggestions improvement.

To carry out these objectives, the six sigma method is used to identify, measure the sigma level of the types of defects that occur in bulk cosmetic products. Determine the dominant defect using Pareto diagram. Analyze and find the root cause of the dominant defect using Ishikawa diagram. Proposed improvements to the root cause of the problem using the 5W1H tool and to ensure the proposal is effective, it is proposed to use the SOP for the production process.

The results show that there are 2 factors that contribute to dominant defects, namely inappropriate viscosity of 60% and pH levels of 40%. The sigma values for the two types of defects are 2.59479 and 2.86963 respectively. From the results of the analysis with the Ishikawa diagram, it is concluded that there are 4 sources of root causes of the problem, namely from human, material, machine and environmental factors. 5 improvement proposals were submitted using the 5W-1H tool.

To test the effectiveness of the proposal, an SOP was made as a guide in the production process of cosmetic cream preparations. Product defects are recorded and analyzed then the sigma value is measured.

***Keywords :***

product defects, six sigma, cosmetic products, Pareto diagram, Ishikawa diagram

## 1. Introduction

Quality control aims to reduce product defects. Product defects will have a direct impact on greater process costs as well as indirectly disrupt the performance of product delivery to customers which causes decreased customer satisfaction. Quality control starts from controlling raw materials, process quality to market-ready products.

PT XYZ, a cosmetic product manufacturing company, faces the problem of high defects **in cosmetic cream products**. Based on production data from January to December

2023 from a total of 269 batches of products from various types of product names there are 131 batches that contain defective products with details of 52 due to inappropriate pH and 79 due to inappropriate viscosity.

To provide a proposal for solving the problem above, the Six sigma method and Pareto diagram tools, Ishikawa diagrams and 5W-1H are used. Six sigma aims to improve process performance until almost no errors occur. In six sigma there is a sigma level which is used as a measure of products that experience process errors, where the sigma level shows the number of defects that can occur in one million opportunities. Six sigma itself means in 1 million opportunities, indicating that the number of defects that can occur is 3.4 products. The stages of implementing six sigma are DMAIC, which stands for Define-Measure-Analyze-Improve and Control. Based on the description above, this research will discuss the application of the six sigma method for quality control of the production process of cosmetic cream preparations at PT XYZ.

## 2. Methods

The stages in completing this research use methods and techniques that will be explained as follows:

### 2.1. Data collection techniques:

Literature Study: conducted to obtain library literature in the form of scientific articles and books related to the problems discussed.

Discussions and interviews: conducted with parties directly involved in the problem being analyzed to obtain more detailed information.

Observation technique: carried out to obtain primary data such as: Total production of cosmetic cream preparations throughout the period of 2023, type and number of product defects throughout the period of 2023.

The results of collecting data on the number of products, types and number of defects for the period of 2023 are shown in table 1.

Table 1. Data on the number of product defects of cosmetic *cream* preparations

| Month | Quantity (Batches) | Number of non-conforming batches per product | | | |
|---|---|---|---|---|---|
| | | Color does not match | pH is not suitable | Viscosity does not match | Presence of microbes |
| 1 | 26 | - | 7 | 9 | - |
| 2 | 31 | - | 2 | 15 | - |
| 3 | 31 | - | 12 | 7 | - |
| 4 | 15 | - | 4 | 9 | - |
| 5 | 21 | - | 5 | 7 | - |
| 6 | 28 | - | 6 | 6 | - |
| 7 | 24 | - | 2 | 6 | - |
| 8 | 19 | - | 4 | 1 | - |
| 9 | 20 | - | 4 | 3 | - |
| 10 | 19 | - | 2 | 7 | - |
| 11 | 10 | - | 1 | 4 | - |

| | | | | | |
|---|---|---|---|---|---|
| 12 | 25 | - | 3 | 5 | - |
| Total | 269 | | 52 | 79 | |

### 2.2. Analysis Technique

The analysis stage is carried out using the Six Sigma method with the DMAIC (Design-Measure-Analyze-Improve-Control) stage:

1. Define
   Determine the types of defects that occur in the process
2. Measure
   Perform quantitative data calculations to find out how the condition of product quality in the company.
3. Analyze
   Analyze to find the root cause of problems with quality
4. Improve
   Provide suggestions for improvement after identifying the root cause of the problem
5. Control
   Ensure improvement proposals can be executed effectively.

## 3. Results and Discussion

By using the six Sigma method approach, the analysis and proposal for product quality improvement of cosmetic cream preparations are as follows:

**Define**

Table 1. Shows the types of defects that occur in the Cosmetic Cream Production process, namely pH is not suitable and viscosity is not suitable. So CTQ (Critical To Quality) in this case = 2

**Measure**

At this stage, the DPMO (Defect Per Million Objects) calculation is carried out to determine the sigma value achieved from the production process. The DPMO calculation starts by calculating DPO (Defects per opportunities) with the formula:

$$DPO = \frac{jumlah\ kecacatan}{jumlah\ produksi\ x\ CtQ} \quad (1)$$

$$DPMO = \frac{jumlah\ kecacatan}{jumlah\ produksix\ CtQ} X\ 1.000.000 \quad (2)$$

To further calculate Sigma is done using the following Ms. Excell software:

$$SIGMA = normsinv\left(\frac{100000-DPMO}{1000000}\right) + 1{,}5 \quad (3)$$

The results of the Sigma calculation for both types of defects are presented in table 2 and table 3 below:

| Month | Batch Quantity | Number of pH discrepancies | CTQ | DPO | DPMO | SIGMA |
|---|---|---|---|---|---|---|

Table 2.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 26 | 7 | 2 | 0,134615 | 134615,4 | 2,60484 |
| 2 | 31 | 2 | 2 | 0,032258 | 32258,06 | 3,34860 |
| 3 | 31 | 12 | 2 | 0,193548 | 193548,4 | 2,36489 |
| 4 | 15 | 4 | 2 | 0,133333 | 133333,3 | 2,61077 |
| 5 | 21 | 5 | 2 | 0,119048 | 119047,6 | 2,67976 |
| 6 | 28 | 6 | 2 | 0,107143 | 107142,9 | 2,74187 |
| 7 | 24 | 2 | 2 | 0,041667 | 41666,67 | 3,23166 |
| 8 | 19 | 4 | 2 | 0,105263 | 105263,2 | 2,75212 |
| 9 | 20 | 4 | 2 | 0,1 | 100000 | 2,78155 |
| 10 | 19 | 2 | 2 | 0,052632 | 52631,58 | 3,11986 |
| 11 | 10 | 1 | 2 | 0,05 | 50000 | 3,14485 |
| 12 | 25 | 3 | 2 | 0,06 | 60000 | 3,05477 |
| TOTAL | 269 | 52 | 2 | 0,094126 | 94125,59 | 2,86963 |

DPMO and Sigma values of the defect type pH nonconformity

From table 2 above, the average DPMO value is 94125.59 with a Sigma value of 2.86963. Based on this value, it shows that the process cannot be said to be good.

Table 3. DPMO and Sigma values of defect type Viscosity not conforming

| Month | Batch Quantity | The amount of Visco does not match | CTQ | DPO | DPMO | SIGMA |
|---|---|---|---|---|---|---|
| 1 | 26 | 9 | 2 | 0,173077 | 173077 | 2,44208 |
| 2 | 31 | 15 | 2 | 0,241935 | 241935,5 | 2,20009 |
| 3 | 31 | 7 | 2 | 0,112903 | 112903,2 | 2,71123 |
| 4 | 15 | 9 | 2 | 0,3 | 300000 | 2,02440 |
| 5 | 21 | 7 | 2 | 0,166667 | 166666,7 | 2,46742 |
| 6 | 28 | 6 | 2 | 0,107143 | 107142,9 | 2,74187 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | 24 | 6 | 2 | 0,125 | 125000 | 2,65035 |
| 8 | 19 | 1 | 2 | 0,026316 | 26315,79 | 3,43793 |
| 9 | 20 | 3 | 2 | 0,075 | 75000 | 2,93953 |
| 10 | 19 | 7 | 2 | 0,184211 | 184210,5 | 2,39943 |
| 11 | 10 | 4 | 2 | 0,2 | 200000 | 2,34162 |
| 12 | 25 | 5 | 2 | 0,1 | 100000 | 2,78155 |
| TOTAL | 269 | 79 | 2 | 0,151021 | 151021 | 2,59479 |

From table 3 above, the average DPMO value is 151021 with a Sigma value of 2.59479. Based on this value, it shows that the process cannot be said to be good.

**Analyze**

At the analyze stage, an analysis is carried out using an Ishikawa diagram. Based on the observation of 320 samples of cosmetic cream products which have several defects of pH not according to specifications or viscosity not according to specifications, an Ishikawa diagram analysis is carried out to find out the root causes of these types of defects. The analysis involves personnel who are directly involved in the production process of cosmetic cream preparations, namely production operators, production supervisors, QC analysts, and material warehouse supervisors.

The results of the fishbone diagram are as shown in Figure 1 and Figure 2 below:

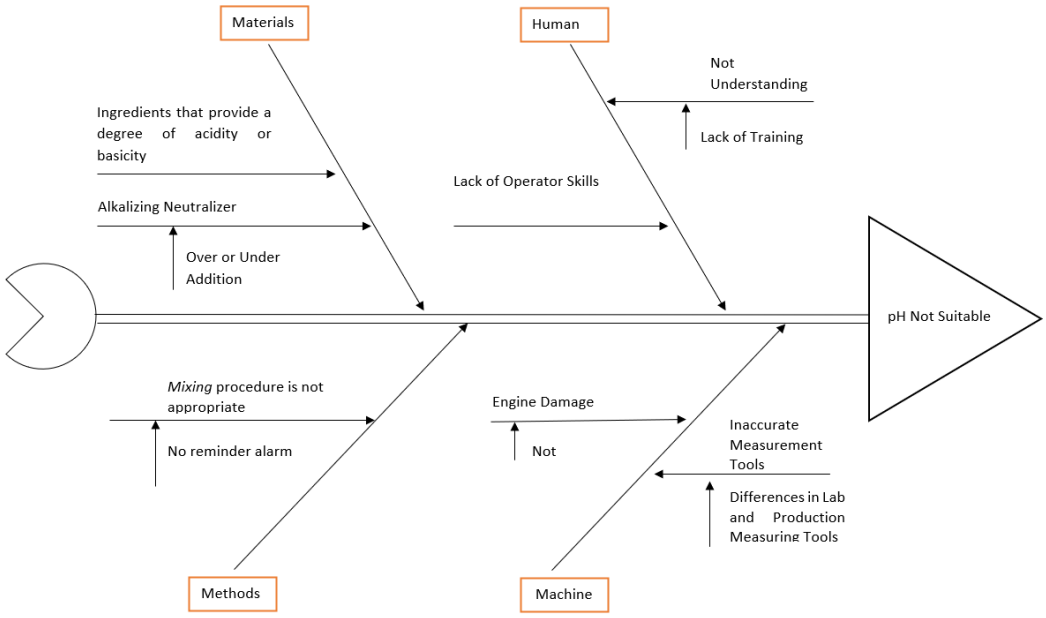


Figure 1. *FishBone* Diagram of pH Discrepancy

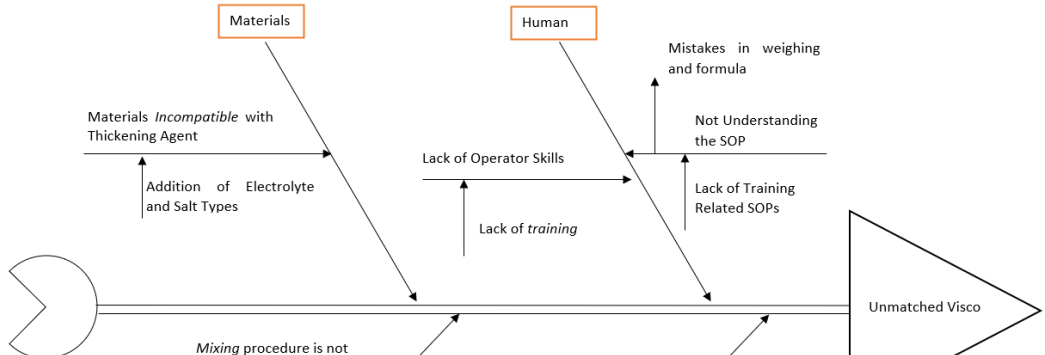

Figure 2. *FishBone* Diagram of Nonconforming Viscosity

**Improve**

After the root cause of the problem of the two types of defects is known, the next step is for the team to propose an improvement plan in an effort to eliminate the causes of product defects or process failures to achieve maximum performance based on the results of data analysis. The improvement plan that will be carried out is based on analyzing the most likely causes of defects in cosmetic cream products. The proposed improvement plan uses the 5W-1H toll (What, When, Where, Which, Who, and How) are shown in table 4.

Table 4. The proposed improvement plan uses the 5W-1H toll (What, When, Where, Which, Who, and How)

| **pH Not Up to Specification** | | | | | | |
|---|---|---|---|---|---|---|
| | ***What*** | ***When*** | ***Who*** | ***Where*** | ***How*** | ***Why*** |
| **Human** | Lack of Training | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | 1. Conduct training at least 2 times in a year.<br>2. Conduct post-training evaluations to gauge operators' understanding and progress. | To improve operators' understanding of SOPs. |
| **Machine** | Differences in measuring instruments measuring instruments in Lab and Production | During the process *mixing.* | Machine operator *mixing.* | *Mixing* area *cream* preparation cosmetic products. | Purchased new measuring instruments similar to those used in the Lab. | To ensure the accuracy of the tool because the pH meter used is produced less thoroughly. |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Materials** | Excessive or reduced addition of alkaline neutralizing ingredients. | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | Establish written standards regarding the amount of addition of alkaline neutralizing agent. | To prevent over- or under-adding. |
| **Methods** | There is no reminder alarm. | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | Provide reminder alarms in the production area. | To prevent the *mixing* process from taking too long or too fast. |

| **Non-specified Visco** | | | | | | |
|---|---|---|---|---|---|---|
| | ***What*** | ***When*** | ***Who*** | ***Where*** | ***How*** | ***Why*** |
| **Human** | Lack of training related to SOP | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | 1. Conduct training at least 2 times in a year.<br>2. Conduct post-training evaluations to gauge operators' understanding and progress. | To improve operators' understanding of SOPs. |
| **Machine** | The stirrer used is not suitable. | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | 1. Create a new policy regarding stirrer selection criteria based on the type of product and material used.<br>2. Provide training to operators on the new policy and how to use it in mixer selection. | To reduce the risk of using unsuitable stirrers that may result in unsuitable production output. |
| **Ma** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Addition of electrolyte and salt types. | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | Conduct open discussions between the R n D team and production regarding materials that are incompatible with thickening agents. | To prevent the addition of electrolyte and salt types that are incompatible with the thickening agent. |
| **Methods** | There is no reminder alarm. | During the process *mixing.* | Machine operator *mixing.* | *Mixing* machine cosmetic products *cream* preparations. | Provide reminder alarms in the production area. | To prevent the *mixing* process from taking too long or too fast. |

**Control**

This stage aims to maintain and control the changes that have been made in the improve stage. The control stage has the function of supervising and monitoring the improvement process. For this stage, a Standard Operating Procedure (SOP) is needed as a reference for operators so that the production process runs properly and no more deviations occur. The following is the format of the Check sheet made:

| | PT BIO KUSUMA<br>TANGERANG – INDONESIA<br>FORM COMPLAINT & CORRECTIVE ACTION |
|---|---|

Tanggal
Temuan :
Departement :

| Jenis Temuan | Analisa Penyebab | Corrective Action | Preventive Action | Due Date | Tgl Verifikasi | Status |
|---|---|---|---|---|---|---|
| | Man :<br>Methode:<br>Material:<br>Machine:<br>Enviroment: | | | | | |

| Dilaporkan Oleh: | Disetujui Oleh: | Diketahui Oleh: |
|---|---|---|
| | | |
| Nama: | Nama: | Nama: |

Figure 3. *Complain & Corrective Action Form*

## 4. Conclusion

Based on the results of the analysis and discussion that has been carried out on the data obtained from PT XYZ, the following conclusions can be drawn:

1. Based on the production process of cosmetic *cream* preparations, there are 2 factors that cause defects in the product, namely: pH not according to specifications with 40% defect proportion and Viscosity not according to specifications with 60% defect proportion.
2. The proposed improvements needed for the company are:
   a. Revise the SOP by adding the suggestions that have been submitted in the 5W-1H table.
   b. Ensure the control process runs effectively by using the "*complaint & corrective action* form" check sheet. So that if there are deviations that occur, improvements and prevention can be made immediately related to these deviations.

## 5. Advice

Because the revised SOP is related to the work process in the workshop area, it should be:

1. SOPs are posted in areas that are easily read by operators
2. A short briefing is conducted before starting work to remind employees to always comply with SOPs in their work.

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