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Reduction Bottle Cost of Milkuat LAB 70 ml Using Optimal Parameter Setting with Taguchi Method

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ABSTRACT

The profit margins decrease up to 30%; the bottles are as the main cause of 10%. This study focuses on bottle analysis and aims to get the optimal weight of the Milkuat LAB 70 ml bottle by not forgetting about some standard parameters that cannot be changed. This experiment uses the Taguchi method, which includes knowing the factor level settings, optimal settings, optimal bottle weight, optimal bottle strength, getting QLF (Quality Loss Function), results from transportation test, and reject ratio in the production line. And some additional methods such as transportation tests have also carried out in this study. The results of this study are that the influential level factor settings are S2 and S4, for setting the optimal level is S2 (A3) is 1.25 mm and bottle S4 (B3) is 0.95 mm, the optimal bottle weight is 7.00 gr from before 7.80 gr, with current bottle strength 19.64 Kg with the previous weight is 19.80 Kg, the value of QLF (Quality Loss Function) is IDR. 7,000, - from before is IDR. 7,815, - deviation of IDR. 16.02, - and efficient per Day IDR. 28,836,000, - with output 1,800,000 bottles per day and the results of transportation tests remain on 22 cartons stack; the reject decline production ratio is not too much different for 1 hour production, 1 production shift and up to 1-3 months of production using a bottle of 7.00 gr with the conclusion of the statistics that is "Not Significant Difference from 7.80 gr" that means that the results are good in productivity and cost efficiency.

1. Introduction

In the industrial world of beverage, Indonesia had rapidly and greatly improved the innovation of various products to create a huge market in Indonesia. In this case, the dairy company had been doing a lot of improvements to keep the "Magic Price" of LAB (Lact Acid Beverage) with a total of 70 ml stable with the primary purpose of the reasonable price compared with the previous one.

In the process of explaining the profit margin of the 70 ml LAB product, there were some significant drops at the start of 2018 and there have been signs of a decline from the end of 2017. The decline in profit margins from the end of 2017 (from October 2017 to January 2018) is 30% in fruit product calculations. From August 2017, the company still had a profit margin of 41% and continued to fall

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until January 2018. Therefore, the company has only earned a profit margin of 11% of each product's sales with a standard of 38%. The system of cost reduction strategy in the company, which has been designed and calculated per COVI (Cost Out Value In) is the program of the company that continues to discuss every project in the company. In the development of this product (Milkuat 70 ml LAB), there were some data that had been analyzed and shown that the most influential inflation price in Indonesia is a very high increase in "Bottle" packaging with HDPE plastic material that affects as much as 10%.

The company has Milkuat 70 ml LAB product standard in pallet and in truck or container stack for delivery process. Because in this stage of development, the main purpose is to reduce expenses (costs) without reducing other aspects including the 70 ml LAB product distribution process and to compile the Milkuat product remains in the old condition until 22 compiles. The identification of this problem will be explained in the company with 70 ml LAB product. Milkuat has many problems that have contributed in very little profit margin in 2018; here are some of the following problems: What are the factors that greatly affect load/load burden on Milkuat 70 ml LAB bottles? What is the optimum level setting for some bottles that are very critical in the production process of Milkuat 70 ml LAB? What is the most optimal and most effective bottle weight that can be recommended for use? What is the difference between bottled bottles before optimization and after optimization? How much is the difference between bottle cost and quality loss function (overall) calculation in this study? How is the result of transportation test as the real test in Milkuat 70 ml LAB product? How much is the difference between the rejects before improvement and after improvement?

2. Literature Review

Production costs are the main component that must be considered when the company will generate production because all company want to be profitable. Therefore, the need for understanding of the theories of production costs for a company can take into account the costs that will be incurred to produce the output of the goods. The understanding of production theory is very important for a company because the company can take into account the costs required to produce a product, and the company can determine the unit price of the goods.

According to Taguchi’s method, the quality is measured through community-induced losses (not just customers) during product use as a result of product performance deviations from target values in planning (working variations) and side effects arising during product use, which are not related to product functions. As the loss decreases, the product quality will increase. At least, there are two factors that cause the loss. First, the loss occurs when the producer ran into rejection of improvement or reinforcement the product performance because of a decrease in target performance. Second, the loss is caused by inconvenience user, financial performance or damaging effects of product use [14].

Production costs are divided into two categories: Explicit costs and Implicit costs. Explicit cost is the cost that are clearly incurred in obtaining the factors of production (value and all inputs purchased for production). Payment is in the form of money to get the factors of production and raw materials required by the company, i.e. labor cost, building lease, etc. Implicit cost also known as Imputed cost is the cost estimation of factors owned by the company's own production and participates in the production process owned by the company, i.e. use of the company's own building [9].

The quality control of a product can be divided into two types: Off line quality control and online quality control. Online quality control is a quality control concept that prioritizes monitoring activities to manufacturing processes to ensure product quality. While, off line quality control is a quality management concept that aims to improve quality by designing products and processes that will be used in manufacturing or service activities [3]. Taguchi method has 4 levels namely product design, production process design, manufacturing, and customer usage [13]. Quality control activities are carried out at each level. Off line quality control encompasses all those activities that are performed before the actual manufacturing of the product. Off line quality control is a principle of quality to improve quality by minimizing the effects of changing causes without eliminating their own causes. Three key stages in the design of the off line quality control process, namely System Design (primary design), Parameter Design (secondary design), and Tolerance design (tertiary design) [1].

Fig. 1. *Picture two quality perspective.*

The quality characteristics (response variables) are the interesting objects of a product or process. The quality characteristics can be grouped according to their target values as follows: Nominal the best, smaller the better, larger the better, signed target, and classified attribute. Experiment with Taguchi's method must observe several steps that are the key for success of the experiment. The experimental design steps of the Taguchi's method are as follows [2]:

- Formulation of the problem.
- The purpose of the experiment.
- Determination of reaction (quality characteristics).
- Identification of influencing factors.

Influencing factors are brainstorming, flowcharting, effect diagram, Pareto analysis and Delphi method.

- Separating of controlled and uncontrolled factors.
- Determination of quantity level and factor level values.
- Identification of interactions between factors.
- Calculation of degrees of freedom.
- Selection of the Orthogonal array.
- Assignment factor on the Orthogonal array.
- Provision of experimental execution.
- Data analysis.
- Result interpretation.

The strategy of experimental design used in the Taguchi method is based on orthogonal arrays and fractional factorial, in which not all possible combinations of factors and levels are tested. It is useful to estimate the effects of main factors on the process. The primary goal of this type of strategy is to obtain so much information about the effect of the parameters on the process with minimal experimental runs. In addition to the fact of requiring a smaller number of experiments, the orthogonal arrays still allow to test the factors using a mixing of number of levels [14].

Quality Assurance runs a quality system, monitors the product, and evaluates it from the product. One of the goals of a critical evaluation program to improve the effectiveness, cost saving, efficiency, and sustainability of EHDI (Early Hearing Detection and Intervention) is to create a program that can detect an abnormal condition and quickly provide feedback from the problem [8]. "The usual problem arises when we do not qualify activities on important work or do quality activities on unimportant jobs; the key is doing quality activities on important jobs" [7]. Here are some quality control tools which will also be used as research analysis tools.

- Check sheet.
- Problem separator (Stratification).
- Histogram.
- Pareto diagram (Pareto Diagram).
- Fish bone diagram.
- Scatter ciagram (Scatter Diagram).
- Map control (control chart).

Quality control tools are highly recommended and should be implemented for each manufacturing industry of many functions in order to facilitate the analysis phase [5].

3. Research Methodology

The first-level package that directly contacts the product is referred to as the “primary package.” For example, a beverage can or a jar, a paper envelope for a tea bag, an inner bag in a cereal box, and an individual candy wrap in a pouch that are the primary packages; their main function is to contain and preserve the product [11]. Primary packages must be non-toxic and compatible with the food and they should not cause any changes in food attributes such as color changes, undesired chemical reactions, flavor, etc. Consumers may instantly recognize products through appetizing pictures or distinctive brands on packaging; even simple transparency of the packaging material can attract consumers by allowing them to view the product inside [10].

Food packaging is defined as a co-ordinated system of preparing food for transport, distribution, storage, retailing, and end-use to satisfy the ultimate consumer with optimal cost [12]. The above research methodology is described in several stages and each level will be explained through the steps taken. A more detailed description of each step will be explained in the following sections. So it is very important to understand what the characteristics of the sample is, so that it can decide what kind of sampling method is suitable to be applied in food and beverage companies, manufacturing, and so forth [6].

1) Research stage.
2) Experiment preparation stage: Trial planning stage begins with identifying quality characteristics that comprise determining quality characteristics and determining measurement systems for each quality feature to calculate experiments. This stage is done to determine the affecting factors and the stage to

be involved in the experiment and be described in an orthogonal array. Specimen preparation including S1, S2, S4-A, S5, and S6. However, for this process it will only be observed in points for S2, S4, S5, and S6 only because for S1 and S4 are non-changeable (b) it is a non-changeable point since the application process is machined by Company.

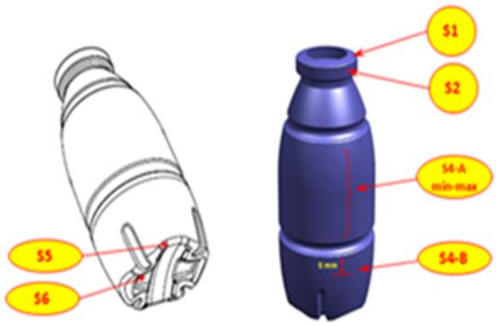

Fig. 2. *3D bottle drawing of Milkuat LAB 70 ml*.

Actual condition measurement includes Actual Stacking Testing, Average Calculation, and Actual Difference.

$$u = \frac{1}{n}\sum_{n=1}^{n} y_i \tag{1}$$

by, μ = mean value, y_i = sample value –*i*, and *n* = number of samples.

The variance calculation uses the following equation:

$$\sigma^2 = \frac{1}{n}\sum_{n=1}^{n}(y_i - \mu)^2 \tag{2}$$

by, σ^2 = variance, μ = mean value, y_i = sample value –*i*, and *n* = number of samples.

Influencing factors in the experiment along with the level setting are Determined; there are some things that must be considered, namely [4]:

- Factor levels: Representing the number of levels or attributes given by the influential factors in the experiment, either controlled factors, noise factors, signal factors, or scale factors.
- Number of factor levels: The number of levels and settings of the selected level depend on the extent to which we know the process or product to be examined.
- Range of factor levels: The wider, distance used in the experiment and the higher, the possibility of finding the effect of factors in determining the quality characteristics.
- Feasibility of factor levels: In selection of levels for each factor it is necessary to consider whether the chosen level allows or can be executed in making a combination of experiments [4].

3) Taguchi experiment design stage.
4) Taguchi experiment implementation stage:

- Data Processing of Taguchi Experiment Result.
- Average calculation and Taguchi experiment SNR.

The mean calculation is done to find out the mean of the test results of the LAB 70 ml, LAB bottle from the 5 samples is taken before that, while the SNR calculation get an overview of how much the variance is. The mean calculation uses the following equations.

$$u = \frac{1}{n}\sum_{n=1}^{n} y_i \qquad (1)$$

by, μ = mean value, y_i = sample value -*i* , and *n* = number of samples.

5) Verification stage

This stage will be discussed about the confirmation experiment as verification and the results of the optimal level setting of Taguchi experiment; the further details are as follows:

- Taguchi experiment of specimen stacking test.
- Data processing of confirmation experiment result.
  - Calculation of mean and variance of verification experiment.

The purpose of calculating the mean value and variance of the conventional experimental results is compared to actual state results. The mean calculation uses the following equation:

$$u = \frac{1}{n}\sum_{n=1}^{n} y_i \qquad (1)$$

by, μ = mean value, y_i = sample value –*i*, and *n* = number of samples.

While the calculation of variance uses the following equation:

$$\sigma^2 = \frac{1}{n}\sum_{n=1}^{n} (y_i - \mu)^2 \qquad (2)$$

σ^2 = variance, μ = mean value, y_i = sample value -*i*, and *n* = number of samples.

- Host test confirmation verification.
- Analysis of confidence intervals to optimum conditions and validation.
  - Comparison of actual and confirmation.
  - Calculation of quality lost functions.
  - Bottle weight stability verification stage.
  - In production line application (reject) verification stage.
  - Application (distribution) – transportation test verification stage.
  - Implementation stage.

4. Data Processing

4.1 Milkuat LAB 70 ml Bottle Specification

Prepare an existing condition exam

Table 1. *Average of weight and stack strength bottles.*

No. spesimen	Weight (gr)	Average Stack Strength (Kg)
1	7.83	20.80
2	7.79	19.20
3	7.82	20.70
4	7.72	18.90
5	7.81	19.40

Average calculations and actual difference

The average value calculation, as follows = 0.785.

Table 2. *Measurement of average value and variation of actual revenue*.

No. spesimen	Stack Power (Kg)
1	20.80
2	19.20
3	20.70
4	18.90
5	19.40
Average	19.80
Variance	0.785

Table 3. *Factors affecting.*

No.	Faktor Terkendali
1	Thickness S2 (A)
2	Thickness S4 (B)
3	Thickness S5 (C)
4	Thickness S6 (D)

Determination of factor stage

Table 4. *Giving factors influencing.*

No.	Factor Controlled	Level 1 (mm) / *Low* -	Level 2 (mm) / *medium* -	Level 3 (mm) / *high* - bottle 8.0gr-
1	*Thickness* S2 (A)	0.45	0.85	1.25
2	*Thickness* S4 (B)	0.55	0.75	0.95
3	*Thickness* S5 (C)	0.45	0.65	0.85
4	*Thickness* S6 (D)	0.85	1.25	1.65

Determination of orthogonal array and number of specimens

The number of experiments to be performed in accordance with the orthogonal arrangement of $L_9(3^4)$ is nine times the replication of every three attempts. Replication was performed to reduce the rate of experimental errors and improved the accuracy of experimental data. So the number of specimens required for the Taguchi experiment is 27.

4.2 Execution of Taguchi Experiment Stage

Table 5. *Taguchi experimental results table.*

No	Factors controlled				R1 (Kg)	R2 (Kg)	R3 (Kg)
	A	B	C	D			
1	1	1	1	1	18.40	17.30	16.10
2	1	2	2	2	18.10	17.10	17.00
3	1	3	3	3	17.10	19.60	19.80
4	2	1	2	3	19.00	18.90	20.34
5	2	2	3	1	19.80	20.00	20.40
6	2	3	1	2	19.70	20.40	19.10
7	3	1	3	2	20.40	20.00	21.30
8	3	2	1	3	20.40	21.30	20.40
9	3	3	2	1	20.30	19.80	19.95

Data processing of Taguchi experiment

1) Average calculation and Taguchi experiment SNR

- Calculation of the average value of a Taguchi experiment u = 17.27.
- Calculation of the average value of the Taguchi experiment is as follows =24.71 dB.

Table 6. *Taguchi experiment average schedule and SNR score.*

No	Factors controlled				R1 (Kg)	R2 (Kg)	R3 (Kg)	Rata-rata	SNR
	A	B	C	D					
1	1	1	1	1	18.40	17.30	16.10	17.27	24.71
2	1	2	2	2	18.10	17.10	17.00	17.40	24.80
3	1	3	3	3	17.10	19.60	19.80	18.83	25.44
4	2	1	2	3	19.00	18.90	20.34	19.41	25.75
5	2	2	3	1	19.80	20.00	20.40	20.07	26.05
6	2	3	1	2	19.70	20.40	19.10	19.73	25.89
7	3	1	3	2	20.40	20.00	21.30	20.57	26.25
8	3	2	1	3	20.40	21.30	20.40	20.70	26.31
9	3	3	2	1	20.30	19.80	19.95	20.02	26.03

2) Statistical analysis of values and variance

- Computation Analysis of the Average Value variance.
  - Calculation of the average value of all experiments = 19.33.
  - Calculation of the average value of each factor level = 17.83.

Create the reaction table and the reaction graph for the mean value.

Table 7. *The reaction graph for the mean value.*

	A	B	C	D
Level 1	17.83	19.08	19.23	19.12
Level 2	19.74	18.39	18.94	19.23
Level 3	20.43	19.53	19.82	19.65
Difference	2.59	1.14	0.88	0.53
Ranking	1	2	3	4

It can be seen that factor A level 3 has the highest follow strength compared with level 1 and 2; the highest factor B is level 3; the highest factor C is level 3; the highest factor D is level 4.

- Calculation of the total number of plots = 10141.87.
- Calculation of the number of plots because min = 10088.52.
- Calculation of the number of boxes due to factors.
  The deviation from the target for factor A, respectively A1, A2 and A3 has 9 experiments = 35.60.
  Calculation of the sum of squares due to factors B, C, and D are equal to the above calculations.
- Calculation of the number of squares due to error = 2.85.
- Determining the degrees of freedom of variance.
- Example factor A = 3 - 1 = 2.
- Calculation of the mean sum of squares.
  The mean sum of squared is the division between the squares and degrees of freedom. Example of factor A= 17.80.
- Calculation of the ratio of F-.
  The ratio of F is the division between the mean sum of squared.
- Example factor A: = 111.25
- Calculation of the pure sum of squares.
  Example factor A = 35.28.
- Calculation of the percent contribution.
  Example factor A: = 56.49%.

Based on the variance analysis (min), it is known that factors A and B have a significant effect on the buildup of LAB 70 ml milk bottle strength. This can be seen from the comparison between the F-value ratio and the F-table value, if the ratio of F and Mq are higher than the F-table value, the factor significantly influences to the response variable.

Table 8. *Analysis of variance (mean) table before pooling up.*

Source	Sq	v	Mq	F-ratio	Sq´	rho%	F-table
A	35.60	2	17.80	111.25	35.28	56.49%	3.35
B	12.80	2	7.20	45.00	12.48	19.98%	3.35
C	6.70	2	2.35	8.94	6.38	10.22%	3.35
D	4.50	2	2.25	4.06	4.18	6.70%	3.35
e	2.85	18	0.16	1	4.13	6.61%	
St	62.45	26	2.40		62.45	100.00%	
Mean	10141.87	1					
ST	10088.52	26					

– Pooling up of insignificant factors $= 14.05$; $v\ (pooled\ e) = 22$; $M\ (pooled\ e) = 0.64$.

Table 9. *Variance schedule analysis (min) after pooling up.*

Source	Pool	Sq	v	Mq	F-ratio	Sq´	rho%	F-table
A		35.60	2	17.80	34.23	34.56	55.33%	3.35
B		12.80	2	6.40	13.85	11.76	18.83%	3.35
C	Y	6.70	2	3.35				
D	Y	4.50	2	2.25				
Pooled e		14.05	22	0.64	1	16.13	25.84%	
St		62.45	26	2.40		62.45	100.00%	
Mean		10141.87	1					
ST		10088.52	26					

– Analysis of Variance of SNR Value.

Analysis of variance calculation steps (SNR) are as follows:

– Calculation of means of signal to noise ratio of each factor level $= 24.98$.
– Create the response table and the response graph for SNR.

Table 10. *Response tables for Taguchi experiment SNR values.*

	A	*B*	*C*	*D*
Level 1	*24.98*	*25.57*	*25.64*	*25.59*
Level 2	*25.90*	*25.72*	*25.52*	*25.65*
Level 3	*26.20*	*25.79*	*25.93*	*25.91*
Difference	*1.22*	*0.07*	*0.41*	*0.32*
Ranking	*1*	*4*	*2*	*3*

– Calculation of the total sum of the square values.
– Calculation of the sum of squared values using the following formula: = 5943.63.
– Calculation of the number of plots due to the min = 5920.81.
– Calculation of the number of squares due to factor = 12.53.
– Calculation of the number of squares due to error = 1.76.
– Calculation of the degrees of freedom of variance = 3 - 1 = 2.
– Calculation of the mean sum of squares = 6.26.
– Calculation of F-ratio $= 4.47$.
– Calculation of percent contribution $= 62.62$ %.

Variance data analysis (SNR) is seen in the following table.

Table 11. *Variance schedule analysis (SNR).*

Source	**Pool**	**Sq**	**v**	**Mq**	**F-ratio**	**Sq´**	**rho%**	**F-tabel**
A		12.53	2	6.26	3.56	11.49	62.62%	3.35
B		3.34	2	1.67	0.95	2.30	12.53%	3.35
C	Y	2.41	2	1.21				
D	Y	0.07	2	0.04				
Pooled e		1.76	4	0.44	1	3.84	24.85%	
St		17.63	12	10.94		17.63	100.00%	
Mean		5920.81	1					
ST		5943.63	9					

Optimal arrangement determination

Table 12. *The influence of table comparison factors.*

Faktor	**ŷ**	**σ**	**Influence**	**Using**
A	√1	√1	Average and variance	A3
B	√2	√2	Average and variance	B3
C	X	X	No effect	C3
D	X	X	No effect	D3

Description: √ Demonstrating these factors is important and X addresses non-critical factors. The number next to √ indicates the rank (based on the reaction table).

In the comparison table, the effect of the above factors results in the combination of optimum factor level: A3 and B3.

Optimal optimized hose capability calculations

1) Response prediction and optimum confidence interval for mean value $= 20.63$
   The confidence interval from prediction of mean value can be calculated by the following formula: = 5.4.

Therefore, the confidence interval for the optimum process average is: $19.92 \leq \mu_{predicted} \leq 21.34$.

2) Response prediction and optimum confidence interval for SNR

- Calculation of all SNR mean with the formula: $\bar{n}$ = Overall SNR experiment data = 25.70 dB.
- Calculation of SNR on optimal prediction state with formula $= 14.26$ dB.
- The predicted SNR confidence interval can be calculated by the following formula = 1.8.
- Then pause predictive confidence can be calculated as follows $= 1.86$ Kg.
- Therefore, means of confidence interval of the optimal state is: $18.77 \leq \mu_{predicted} \leq 22.49$.

4.3 Verification Stage

Table 13. *Taguchi experiment stacking test.*

No. specimen	Weight (gr)	Stack Power (Kg)
1	7.04	19.5
2	7.07	19.8
3	7.10	20.1
4	7.09	19.9
5	6.98	18.9

1) The calculation of the mean value and variance of the validation experiment are shown in the following table:

Tabel 14. *Verification experiment table of schedules.*

No. spesimen	Stack Power (Kg)
1	19.5
2	19.8
3	20.1
4	19.9
5	18.9
Average	19.64
The difference	0.281
SNR	25.86

Average value calculation= 19.64. Although the calculation of variance uses the following equation = 0.218. Calculation of SNR for validation experiment results is as follow- 18.86 dB.

2) Calculation of the confidence interval of validation experiment

- The confidence interval from the average value of validation experiment = 1.02 dB. Therefore, the confidence interval is as follows: $18.62 \leq \mu_{predicted} \leq 20.66$.
- The confidence interval of SNR value of validation experiment =1.14 dB.

Therefore, the confidence interval for the optimum process average is: 17.72 ≤ μ_predicted≤ 20.00.

Confidence interval of optimal condition and confirmation

Table 15. *Comparison table of initial terms with authorization.*

	Initial	Confirmation
Average	19.80	19.64
Variance	0.785	0.218

Comparison of the initial state result with the validation experiment result uses the hypothesis testing with two different mean. Here is the hypothesis testing steps to compare the initial state result with the validation experiment result.

- Hypothesis Formulation.
- Level of significance (α) = 0.05.

– The degrees of freedom = 5 + 5 – 2 = 8.
– *t* table = $t(\alpha/2;n1+n2\text{-}2) = t$ 0.05(8) = 1.860.
– Making decisions.
– Calculation of *t0* value, = 0.357.
– Conclusion.
Since t count (0.357) is greater than t table (-1.860) then hypothesis is accepted.
The results of the above hypothesis test that the stacking strength of Milkuat LAB 70 ml product from optimum level setting is not much different from the actual state $(\mu_1 < \mu_2)$.

Calculation of quality lost functions

Table 16. *Calculation of quality lost functions.*

	Initial	**Confirmation**
Average	19.80	19.64
Standard deviation	0.886	0.466

After the data is obtained, it can calculate the quality loss function by using the formula is as follow:

1) Real situation

Table 17. *Actual value calculation table* A_0.

No	Name of Materials	(%)	Used (gr)	Price per Kg (IDR)	Total (IDR)
1	HDPE Plastic	98.50%	7.68	19,600	150.53
2	Master Batch (white)	0.50%	0.04	54,600	2.19
3	Material Recycle	1.00%	0.08	4,000	3.58
Total		100%	7.80	-	156.30

$k = A_0 \, x \, \Delta_0^2 = 156.30 \, x \, 5.00^2 =$ IDR 3907.50. When the cost coefficient is known, the quality loss function can be written as follows = IDR.7.815.

Table 18. *Optimal* A_0 *value calculations.*

No	**Name of Materials**	**(%)**	**Used (gr)**	**Price per Kg (IDR)**	**Total (IDR)**
1	HDPE Plastic	98.50%	6.9	19,600	135.24
2	Master Batch (white)	0.50%	0.03	54,600	1.64
3	Material Recycle	1.00%	0.07	4,000	3.14
Total		100%	7	-	140.02

2) Optimal conditions
To calculate the quality loss function of IDR 140.02, $k = A_0 \, x \, \Delta_0^2 = 140.02 \, x \, 5.00^2 =$ IDR 3500.50. When the cost coefficient is known, the quality loss function can be written as follows:
$L(Y)_{actual\ situation}$ = IDR 7.000. The result of the loss-loss function in the pre-and post-optic conditions can be seen clearly in table 4.20.

Table 19. *QLF value table for the company*.

QLF	
Early	Optimization
7.815	7.000

Based on the data summarized in table 4.20, it is shown that the value of the quality loss function performed after optimization is less than the initial condition prior to optimization. This development can be reduced by the price incurred by company and if viewed from the percentage of cost savings it is estimated 10.42% of the conditions before development.

Stability verification of bottle weight stage

Based on discussions with team project and the decisions of the lead manager this will continue for the next step of verification of application dilution testing and transportation test. If all have been successful then it will be seen again from the stability of the weight distribution of this Milkuat 70 ml LAB bottle.

5. Analysis

Bottle weight analysis and actual optimization (confirmation)

The actual bottle analysis and optimization (confirmation) is a summary of the results obtained from previous calculations which are of several methods used and calculated from the start of preparation to the most influential factors that can be reduced and maximized. Based on the previous data the bottle used by company is 7.80 gr with specification (7.50 - 8.10). However, after optimization, the process is done; it is shown that the optimal bottle weight is 7.00 gr with specification (6.70 - 7.30). So from earlier in this study get weight loss of 0.80 gr.

Analysis of influential factors

Based on the data obtained from the calculations, Table 9 shows either F-ratio or Mq is smaller than the F-tables in the C and D factors. Thus the two factors can be categorized no significant effect on the strength of the bottle stack Milkuat LAB 70 ml (stacking strength). From the data, it can also be categorized by a larger value of F-ratio and Mq when compared to F-tables on factors A and B. It can be concluded that A and B are the factors influencing the pile strength of the LAB 70 ml.

Determination analysis of optimal level setting

Based on the data from the previous, the most optimal calculations are A3 and B3, namely the setting A3 = 1.25 mm and B3 = 0.95 mm. Based on the result, A and B level are the most influential, then in this study the key of bottle weight reduction will be taken from level C and D. And in this study, level C and D will use experiment setting level that is at C = 0.45 mm and D = 0.85 mm. The result of this section is an important point when getting optimal weight is 7.00 gr.

The analysis of actual bottle strength and optimization (confirmation)

After the bottle weight was lowered from 7.80 gr to 7.00 gr, it did not get a significant impact from the strength of the bottle because the point where the weight reduction is not a factor affecting the strength of the bottle Milkuat LAB 70 ml. And from the data obtained bottle weighing 7.80 gr, it has a stacking power of 19.80 Kg while the bottle that has been optimized using Taguchi method is 19.64 Kg. From this data, it can be concluded that it is not much different from the previous bottle.

QLF analysis (quality loss function)

From the results of the actual calculation and optimization (confirmation) in terms of searching the level of influence on the determination of the optimal and final level setting of the research with the help of Taguchi's method, is to calculate the value of QLF (Quality Loss Function). The calculation of QLF (Quality Loss Function) can be summarized with the initial result IDR 7,815. However, after the optimization process it decreases by IDR 7,000, or a drop in the price per bottle is IDR 156.30 to 140.02 or about IDR.16.02.

Analysis of Milkuat LAB 70 ml bottle application after optimization (short trial)

After obtaining the optimal level setting and obtaining the desired weight from LAB 70 ml bottle, based on data from that obtained at the time of optimization analysis with the weight of 7.00 gr bottle was previously 7.80 gr. Based on the application that is done in the application stage (reject) in production line, the data shows that the reject is not much different from the previous one or it can be said that "not significantly difference", which means that from development side it is acceptable of the specified standard.

Analysis of Milkuat LAB 70 ml bottle applications in distribution test

Based on the application carried out at the transportation stage, it has been shown that two stacking options during the transportation test process to Lombok are 21 cartons and 22 cartons, indicating that for the stack of 22 cartons after checking with the standard quality 100% both from outside (carton) and inside (product inside carton). There is no discrepancy of critical products such as leaking or bottled dents.

Implementation stage analysis (long trial)

After getting good data from all things, in order to be effective, the recommendation is to continue in the implementation phase of long-term production in line. At the implementation stage, a project has been said to be very mature from the introductory data because it can be recommended for the implementation of Milkuat LAB 70 ml in production line.

6. Conclusion and Suggestion

Here are some conclusions that answer the purpose of this study.

- Factors affecting the strength of the stack (strength stacking) of the Milkuat LAB 70 ml bottle are the thickness of body parts S2 and bottle S4 bottle section.
- The optimal level setting for the section of the S2 (A3) bottle is 1.25 mm and the S4 (B3) bottle is 0.95 mm.
- After the optimal level setting obtained, the bottle weighing is 7.00 grams by not reducing the volume or content of the product.

- Based on the data, it is found that for the bottle weighing 7.80 gr it has a stacking power of 19.80 kg while the bottle that has been optimized to weight 7.00 gr has a stacking power of 19.64 kg and its meaning does not greatly differ from before.
- Differences QLF from the previous IDR 7.815 after optimization (confirmation) is IDR 7,000 or a drop in the price per bottle is IDR 156.30 to 140.02 or about IDR.16.02. Bottle consumption per day about 1,800,000 bottles means per day can save IDR 28.836.000.
- The results of transportation test experiment conducted to Lombok on this Milkuat bottle indicate that data can still be received if using a stack of 22 cartons.
- Comparison of rejection in production line shown that the data not significantly difference from the previous bottle, same as the results of production comparison for 1 hour of production, 1 shift production up to 1-3 months production by using this 7.00 gr bottle with the conclusion of the statistic that is "Not Significantly Difference from 7,80 gr ".

Here are some suggestions from this study to be able to make a better follow-up study.

- The need for control is done with the same thing and based on this fact, Quality Performance from Milkuat LAB 70 ml bottle can be observed with weight 7.00 gr, this with long term at least 3 months up to 5 or 6 months.
- The company must be consistent that in the development process it must have the principle of COVI (Cost Out Value In); in cooperation with all parties, it will get a condition that always survives with a raise or fluctuation in Indonesia.
- We are committed to budget 2018-2020 for productivity mindset, this must always be maintained with a spirit that continues to be leveled to get the condition achieved by Company.

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