Defect Analysis Of Quality Palm Kernel Meal Using Statistical Quality Control In Kernels Factory

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Abstract. The production quality has an important impact retain the totality of characteristics of a product or service to pay attention to its capabilities to meet the needs that have been established. Quality criteria Palm Kernel Meal (PKM) set Factory kernel is as follows: oil content: max 8.50%, water content: max 12.00% and impurity content: max. 4.00% While the average quality of the oil content of 8.94%, the water content of 5.51%, and 8.45% impurity content. To identify the defective product quality PKM produced, then used a method of analysis using Statistical Quality Control (SQC). PKM Plant Quality Kernel shows the oil content was 0.44% excess of a predetermined maximum value, and 4.50% impurity content. With excessive PKM content of oil and dirt cause disability content of production for oil, amounted to 854,6078 kg PKM and 8643.193 kg impurity content of PKM. Analysis of the results of cause and effect diagram and SQC, the factors that lead to poor quality of PKM is Ampere second press oil expeller and hours second press oil expeller.

1. Introduction
Kernel factory is a manufacturing company engaged in the manufacturing Palm Kernel Oil (PKO) and Palm Kernel Meal (PKM) as by-products. PKM many production processes produce a defective product, where the quality of the resulting PKM is considered less good because it does not meet the quality standards set by the company. Quality criteria PKM set Factory kernel is as follows: oil content: max 8.50%, water content: max 12.00% and impurity content: max. 4.00% While the average quality of the oil content of 8.94%, the water content of 5.51%, and 8.45% impurity content.

Quality is a systematic approach that the products or services in accordance with the specified requirements [1]. It is also an operating system as the corrective measures to produce economic goods and services and meet customer needs.

Quality consists of the development, design, production, marketing, and service of products and services [2]. Each of these activities is done well would be up to the consumer with excellent product quality and at a low cost. It needs to continue to do that with the continuous development of quality. Statistical Quality Control (SQC) is a branch or part of the quality control in which the control process is to collect, analyze and interpret the data used in quality control activities [3, 4, 5, 6].

The problem-solving process and quality improvements using quality control tools through the problem-solving process so that it becomes more rapidly and systematically. Quality control tool can be used by professionals to facilitate the process of quality improvement [7,8]. In this study addressed
the use of Statistical Quality Control Plant Kernel. Variables used in this research is the quality of PKM. This study aims to identify product defects that occur.

2. Methodology/Experimental
Type of research is applied research because this research was done to solve real problems that occur in the plant that is the problem of quality. This research will design improvements to reduce variations in the characteristics are there [9].

2.1. Data Collection Methods
Data collection methods used in this research is through direct observation and interviews with the company. Data processing method used in this study are the implementation of quality control tool to know the data PKM are still within the limits of control and identification of factors that cause deviation PKM quality.

2.2. Data Processing Methods
Methods of data processing techniques in this study with a tool quality control use the statistical quality control to determine the quality of data that is still within the limits PKM control. The results of quality control tools are as follows: Stratification, CheckSheet, Histogram, Scatter Diagrams, Map control, and analysis Cause and effect diagram. Stratification is the process of grouping data defects that occur on the production floor. The criteria selected for the stratification of defects PKM production. Check Sheet or Sheet Inspection is a means of collecting and analyzing data to facilitate the data collection process so that it can present the data to be more communicative and can be converted into information. The examination can be determined by the number of PKM product defective and not defective in units of kilograms. Scatter Diagrams are used to determine the distribution of data each PKM production quality. Map this control is used to see whether the data is the percentage of oil content and impurity content in the production of PKM homogeneous or not. Analysis of cause and effect diagram is used to determine the cause of the high percentage of oil content and degree of dirt on the production of PKM in detail.

![Figure 1. Block Diagram methods of data processing.](image-url)
3. Results and Discussion

3.1. Statistical Quality Control (SQC)

The Statistical Quality Control (SQC) is a control process that is used to collect, analyze and interpret the data used in quality control activities [10,11]. The control process consists of seven tools of quality control, namely:

1. Stratification

Stratification is the process of grouping data defects that occur on the production floor. In addition, stratification also keeps records of the number of defects caused by each type of defects. To determine the number of production defects PKM, do multiplication excess oil and dirt content percentage of the daily production amount PKM. PKM disability stratification can be seen in Table 1.

| No | Quality of PKM Kernels Factory | Number of PKM Production | Number of PKM Defects |
|----|--------------------------------|--------------------------|-----------------------|
|    | Oil Content (maks 8,5%)        | Water Content (maks 12,00%) | Impurities Content (maks 4,00%) |
| 1  | 9.54                          | 5.65                     | 8.49                  | 218963            | 12108.65       |
| 2  | 9.20                          | 5.55                     | 8.48                  | 228779            | 11850.75       |
| 3  | 9.30                          | 5.55                     | 8.44                  | 217252            | 11384.00       |
| 4  | 9.36                          | 5.50                     | 8.47                  | 226180            | 12055.39       |
| 5  | 9.52                          | 5.47                     | 8.46                  | 212608            | 11650.92       |
| 6  | 9.55                          | 5.53                     | 8.48                  | 219401            | 12132.88       |
| 7  | 8.48                          | 5.55                     | 8.44                  | 212207            | 9379.549       |
| 8  | 8.49                          | 5.52                     | 8.46                  | 166555            | 7411.698       |
| 9  | 8.49                          | 5.47                     | 8.47                  | 178450            | 7958.87        |
| 10 | 8.50                          | 5.54                     | 8.44                  | 201274            | 8936.566       |
| 11 | 8.49                          | 5.51                     | 8.50                  | 218258            | 9799.784       |
| 12 | 8.43                          | 5.48                     | 8.50                  | 228308            | 10114.04       |
| 13 | 8.44                          | 5.49                     | 8.42                  | 222911            | 9718.92        |
| 14 | 8.43                          | 5.50                     | 8.44                  | 200022            | 8740.961       |
| 15 | 8.46                          | 5.56                     | 8.43                  | 116956            | 5134.368       |
| 16 | 8.45                          | 5.32                     | 8.42                  | 190750            | 8335.775       |
| 17 | 9.47                          | 5.49                     | 8.40                  | 160082            | 8596.403       |
| 18 | 8.50                          | 5.53                     | 8.49                  | 160945            | 7226.431       |
| 19 | 9.53                          | 5.57                     | 8.46                  | 158199            | 8685.125       |
| 20 | 9.56                          | 5.50                     | 8.47                  | 173618            | 9601.075       |
| 21 | 9.59                          | 5.53                     | 8.45                  | 167092            | 9256.897       |

| Rata=rata | Oil Content (maks 8,5%) | Water Content (maks 12,00%) | Impurities Content (maks 4,00%) | Number of PKM Production | Number of PKM Defects |
|-----------|------------------------|-----------------------------|---------------------------------|--------------------------|-----------------------|
| 8.94      | 5.51                   | 8.46                        | 194229                          | 9528.00                  |

2. Check Sheet or Sheet Inspection

Check Sheet or Sheet Inspection is a means of collecting and analyzing data to facilitate the data collection process so that it can present the data to be more communicative and can be converted into information [12,13]. The data collected through the of defective products check sheet can be seen in Table 2.

| No | Production per | Defective | The Product is not |
|----|----------------|-----------|--------------------|
|    |                |           |                    |                      |
Table 2 (continued)

| No | Day (kg) | Defective products per Day (kg) | The Product is not Defective (kg) |
|----|----------|--------------------------------|----------------------------------|
| 3  | 217252   | 11384.00                       | 205868.00                        |
| 4  | 226180   | 12055.39                       | 214124.61                        |
| 5  | 212608   | 11650.92                       | 200957.08                        |
| 6  | 219401   | 12132.88                       | 207268.12                        |
| 7  | 212207   | 9421.99                        | 202785.01                        |
| 8  | 166555   | 7428.35                        | 159126.65                        |
| 9  | 178450   | 7976.72                        | 170473.29                        |
| 10 | 201274   | 8936.57                        | 192337.43                        |
| 11 | 218258   | 9821.61                        | 208436.39                        |
| 12 | 228308   | 10273.86                       | 218034.14                        |
| 13 | 222911   | 9852.67                        | 213058.33                        |
| 14 | 200022   | 8880.98                        | 191141.02                        |
| 15 | 116956   | 5181.15                        | 111774.85                        |
| 16 | 190750   | 8431.15                        | 182318.85                        |
| 17 | 160082   | 8596.40                        | 151485.60                        |
| 18 | 160945   | 7226.43                        | 153718.57                        |
| 19 | 158199   | 8685.13                        | 149513.87                        |
| 20 | 173618   | 9601.08                        | 164016.92                        |
| 21 | 167092   | 9256.90                        | 157835.10                        |
| Jumlah | | 4078810 | 200079.1 | 200753.57 |

3. Histogram
Histogram for the period PKM production data made a bar graph (histogram) that shows the composition of the number of defects of each type of disability that can be seen in Figure 2.

![Number of Defects (kg)](image)

Figure 2. Histogram PKM Production.
Of the histogram above shows that PKM production defects occur most commonly on the oil content of more than 8.5% and the content of impurities exceeds 4%, so this research is focused on both these factors.

4. Scatter Diagram
Scatter diagram used to see the relationship between the amount of PKM production by the number of defects. Data disability oil content of more than 8.5% and impurity content exceeding 4%, for further presented in the scatter diagram in Figure 3, and Figure 4.

![Figure 3. Scatter diagram Defects Type Oil Content (> 8.5%)](Image)

Based on Figure 2. known that defects of production at most of the oil content (> 8.5%) occurred in the first week and last. Images of a scatter diagram for the production of disability resulting impurity content (Maks > 4%) can be seen in Figure 4.

![Figure 4. Scatter diagram type of defects Impurities Content (> 4%)](Image)

Based on Figure 4. The known that production defects resulting impurity content (Maks > 4%) had a uniform distribution of the data.

5. Map Control (Control Chart)
Map control is used to see whether the data is the percentage of oil content and impurity content in the production of PKM homogeneous or not [14]. If not then do repairs on the data out of control. If homogeneous then repair remains to be done, but as a whole without priority. In this study, used a map control to see the percentage of irregularities in the data content of oil and dirt on the production of PKM used several variables, namely: Central Line (CL), Upper Control Limit (UCL), Lower Control Limit (LCL).

The calculation of the value of CL, UCL and LCL conducted based on data from Table 1. Map control c percentage of oil content in the production of PKM can be seen in Figure 5.
From the graph note that all the data, the percentage of oil content in the production of PKM are at in control. This shows that the data does not require revision because no data is out of control. Image map control C percentage of impurity content on the production of PKM can be seen in Figure 6.

From the graph note that all data on the percentage of impurity content is the production PKM in control. This shows that the data does not require revision because no data is out of control.

6. Cause and Effect Diagram
This diagram is used to determine the cause of the high percentage of oil content and degree of dirt on the production of PKM in detail [15]. The cause of disability levels of oil and dirt levels caused by several factors, such as man, machines, methods, environment, and material. Causal diagram defects oil content can be seen in Figure 7.
Figure 7. Cause and Effect Diagram of Oil Content (> 8.5%) and Impurities Content (> 4.0%)

Based on interviews conducted by the company that the main factors causing the high percentage of oil content and impurity content directly are Ampere second press oil expeller and hours second press oil expeller.

4. Conclusion.
Based on the results of the application identified by using Statistical Quality Control (SQC), it can be concluded as follows: that the processing operation PKM average oil content was 8.94%, while the maximum permissible percentage of only 8.50%. These conditions indicate oil levels had 0.44% excess of a predetermined maximum value. With an excess of the oil content, it will cause a loss of yield of 0.44% x 194,229 kg = 854,607.8 kg PKM. The same thing happens at levels of dirt with an average percentage of 8.45%. Rated maximum percentage allowed is 4.00%, 4.50% means that there are excessive levels of dirt. Thus, the losses suffered by the company due to excessive levels of dirt amounted to 4.50% x 194,229 kg = 8643.193 PKM kg. Analysis of the results of cause and effect diagram and SQC, the factors that lead to poor quality of PKM is Ampere second press oil expeller and hours second press oil expeller.

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