



# Control of Auxiliary Materials in the Biodiesel Process Using the Min-Max Stock Method at PT. Permata Hijau Palm Oleo Belawan

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## ABSTRACT

Control of Auxiliary Materials in the Biodiesel Manufacturing Process Using the Min-Max Stock Method at PT. Permata Hijau Palm Oleo Belawan. The main reason why companies store raw materials in large quantities is as safety stock if there is a delay in delivery from suppliers so that the production process does not stop. This research was carried out on four auxiliary materials used for the Biodiesel manufacturing process, namely, Methanol, Catalyst, HCl, and NaOH at PT. Permata Hijau Palm Oleo Belawan. From the research results, it was found that the final inventory of auxiliary materials during 2022 and 2023 was very large compared to inventory calculations using the Min-Max Stock method, namely for Methanol auxiliary materials, namely 390,182 Kg (2022) and 2,095,097 Kg (2023) compared to using the Min-Max Stock method of 316,852 Kg (2022) and 409,299 Kg (2023), with an investment cost of Rp. 10,898,701,800 Catalyst, namely 1,130,654 (2022) and 1,776,481 Kg (2023) using the Min-Max Stock method of 76,325 Kg (2022) and 92,518 (2023), with an investment cost of Rp. 20,713,186,300, NaOH, namely 173,197 Kg (2022) and 152,905 Kg (2023) with the Min-Max Stock method of 36,466 Kg (2022) and 35,106 Kg (2023) with an investment cost of Rp. 2,107,404,600, HCl namely 130,767 Kg (2022) and 146,161 Kg (2023) using the Min-Max Stock method of 69,337 Kg (2022) and 63,821 Kg (2023) with an investment cost of Rp. 230,552,000. From the research results it can be concluded that controlling the inventory of auxiliary materials at PT. PHPO Belawan is still not optimal. The final inventory of auxiliary materials is still very large and the largest is Methanol auxiliary materials in 2023, Catalyst in 2022 and 2023.

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## 1. INTRODUCTION

Biodiesel is a fuel consisting of a mixture of mono-alkyl esters from a long chain of fatty acids, which is used as an alternative to diesel engine fuel and is made from renewable sources such as vegetable oil or animal fat. Biodiesel fuel has become more attractive because of its benefits to the environment which in this era of globalization, Biodiesel is needed as a replacement for the world's diesel industry, whose raw material is obtained from processed palm fruit. According to the results of the study, it shows that vegetable oil has considerable potential as an alternative fuel for diesel engines (Biodiesel), because it has similar characteristics to diesel engine fuel derived from petroleum.

For biodiesel raw materials at PT. Permata Hijau Palm Oleo Belawan itself is divided into two, namely the main raw material and auxiliary material. The main raw materials at PT. Permata Hijau

Palm Oleo uses vegetable oil derived from palm oil. The palm oil (CPO) has undergone a processing process to become RBDPO (Refined, Bleached and Deodorized Palm Oil). RBDPO is a palm oil that has undergone a refining process to remove free fatty acids as well as purification to remove color and odor removal. As for the biodiesel auxiliary materials themselves, PT. Permata Hijau Palm Oleo Belawan uses Methanol, Catalyst, HCl and NaOH.

To achieve the production target, it is necessary to control raw materials so that there is no zero stock that can stop the factory production process. In carrying out the production process, of course, PT. Permata Hijau Palm Oleo Belawan needs a supply of auxiliary materials to support its production. However, in reality, there is often an excess of auxiliary materials, where the amount of auxiliary materials purchased is not in accordance with the amount of auxiliary materials used in the process of making Biodiesel.

In order for production activities not to be disrupted and the funds invested in the supply of auxiliary materials are not excessive, one of the methods that can be used for the control of auxiliary materials is the Min-Max Stock Method.

The min-max stock method is a method of controlling raw materials based on the assumption that the supply of raw materials is at two levels, namely the maximum level and the minimum level. If the maximum level and minimum level have been set, then by the time the inventory reaches the minimum level, the order of raw materials must be made to place the inventory at the maximum level. This is to avoid too large or too small a supply amount. The application of the min-max stock method is carried out so that the warehouse can find out how much minimum stock must be in the warehouse to meet the production quantity capacity and what is the maximum stock of raw materials in the warehouse so that there is no waste of inventory costs. That way the company will avoid excess inventory which results in waste and the inventory of raw materials that is too small can hinder the smooth production process. In this study, the researcher will examine the auxiliary materials used in the Biodiesel manufacturing process, including Methanol, Catalyst, HCl and NaOH. Where the auxiliary raw material is an important material from the beginning of production to the end in the biodiesel manufacturing process so that biodiesel products with good quality and ready to sell are obtained.

## 2. METHOD

This study uses descriptive analysis techniques using a quantitative approach, meaning that the data obtained in the field is processed in such a way as to provide systematic, factual, and accurate data on the problem being researched. The descriptive analysis technique used to analyze data on the problem of controlling auxiliary materials in maintaining the production process is using the Min-Max Stock method.

The independent variables that affect the control of raw material inventory are:

1. Safety Stock is an additional inventory held to protect or maintain the possibility of a shortage of raw materials caused by the use of raw materials that is greater than originally estimated.
2. Minimum Inventory is the amount of usage during the time of the purchase order calculated from the multiplication between the time of the order and the average usage in one month/week/day plus the safety inventory. In this study, the unit used for lead time is months.
3. Maximum Inventory is the largest amount of inventory that can be held by a company in order to avoid losses due to considerable costs due to excessive procurement and to avoid losses due to lack of materials (stock out).
4. The number of Reorders is the amount that needs to be ordered for replenishment.
5. The use of raw materials is the amount of raw materials used by the company for the purposes of the production process in a certain period.
6. Lead Time is the time required between the time the chemical is ordered and the arrival time itself.
7. Maximum Usage is the largest amount of raw materials used in a given period.

The bound variable that wants to be assessed is Inventory Control Auxiliary materials is an activity of management to determine the amount of inventory in the form of auxiliary materials that are maintained and will be used in the production process by the company.

Data collection is carried out to obtain the information needed in order to achieve the research objectives. The primary data collected is purchase data, usage data from production. Meanwhile, the secondary data in this study is from companies, websites, such as warehouse plans and research data obtained by the author indirectly but obtained from existing data from the Production and Warehouse Department of PT. PHPO – Belawan. The data collection carried out includes a series of the following processes: The data collected is data on the number of purchases and data on the amount of use of auxiliary materials for Biodiesel Manufacturing during the last 2 years, namely from 2022 to 2023.

Data collection includes data on the number of orders and use of Methanol, Catalist, NaOH, HCl. auxiliary materials for the period of 2022 – 2023 and the lead time for the procurement of each auxiliary material.

### 3. RESULTS AND DISCUSSION

#### Methanol Calculation in 2022

The final inventory in 2022 of 390,182 Kg will be the initial inventory in 2023.

Safety Stock = 316.852 Kg

Minimum Inventory = 1.790.862 Kg

Maximum Inventory = 3.264.873 Kg

Re-Order Point = 1,474,011 Kg

Excess Methanol Helper Ingredient = Rp. 444,330,000

#### Methanol Calculation in 2023

The final inventory in 2023 of 2,095,097 Kg will be the initial inventory in 2024.

- Safety Stock = 409.299 Kg
- Minimum Inventory = 1.808.862 Kg
- Maximum Inventory = 3.208.425 Kg
- Re-Order Point = 1,399,563 Kg
- Advantages of Methanol Auxiliary Materials, namely: = Rp. 10,283,367,800

#### Catalist Calculation in 2022

- Initial Stock 2022 : 1,201,700 kg
- Lead Time : 0.7 Months
- End Stock 2022 = 1,130,654 Kg

The final inventory in 2022 of 1,130,654 Kg will be the initial inventory in 2023.

- Safety Stock = 76.325 Kg
- Minimum Inventory = 402.534 Kg
- Maximum Inventory = 728.743 Kg
- Re-Order Point = 326,209 Kg
- Advantages of Catalist Auxiliary Materials are: = Rp. 7,907,467,500

#### Catalist Calculation for 2023

- Initial Stock in 2023 = 1,130,654 kg
- Lead Time = 0.7 Months
- 2023 End Stock = 1,776,481 Kg

The final inventory in 2023 of 1,776,481 Kg will be the initial inventory in 2024

- Safety Stock = 91.518Kg
- Minimum Inventory = 393.421 Kg

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- Maximum Inventory = 695.324 Kg
- Re-Order Point Q = 301,903 Kg
- 2023 Year-End Provisions, namely = 1,776,481 Kg
- Safety Stock in 2023 is =91,518 Kg
- Excess of Catalyst Auxiliary Materials = Rp. 12,805,718,800

#### **NaOH Calculation in 2022**

- Initial Stock 2022 = 55,120 Kg
- Lead Time = 0.5 Months
- End Stock 2022 = 173,197 Kg

The final inventory in 2022 of 173,197 Kg will be the initial inventory in 2023.

- Safety Stock = 8.792 Kg
- Minimum Inventory = 22.629 Kg
- Maximum Inventory = 36.466 Kg
- Re-Order Point = 13,837 Kg
- 2022 Year-End Inventory =173,197 Kg
- Safety Stock in 2022 is =8,792 Kg
- Excess NaOH Helper = Rp. 1,085,073,000

#### **NaOH Calculation in 2023**

- Initial Stock 2023 = 173,197 kg
- Lead Time = 0.5 Months
- End Stock 2023 = 152.905 Kg

The final inventory in 2023 of 152,905 Kg will be the initial inventory in 2024.

- Safety Stock = 4.741 Kg
- Minimum Inventory = 19.923 Kg
- Maximum Inventory = 35.106 Kg
- Re-Order Point =15,183 Kg
- 2023 Year-End Inventory =152,905 Kg
- Safety Stock in 2023 is =4,741 Kg
- Excess NaOH Auxiliary Materials: = Rp. 1,022,331,600

#### **HCl Helper Material Inventory Calculation**

##### **HCl Calculation in 2022**

- Initial Stock 2022 = 52,300 Kg
- Lead Time = 0.7 Months
- End Stock 2022 = 130.767 Kg

The final inventory in 2022 of 130,767 Kg will be the initial inventory in 2023.

- Safety Stock = 69.337 Kg
- Minimum Inventory = 276.169 Kg
- Maximum Inventory = 483.002 Kg
- Re-Order Point = 206,833 Kg
- 2022 Year-End Inventory =130,767 Kg
- Safety Stock in 2022 is =69,337 Kg
- Advantages of HCl Auxiliary Materials, namely = Rp. 172,004,000

##### **HCl Calculation in 2023**

- Initial Stock 2023 = 130,767 kg

- Lead Time = 0.7 Months
- End Stock 2023 = 146.161 Kg

The final inventory in 2023 of 146,161 Kg will be the initial inventory in 2024.

- Safety Stock = 63.821 Kg
- Minimum Inventory = 268.125 Kg
- Maximum Inventory = 472.430 Kg
- Re-Order Point Q = 204,305 Kg
- 2023 Year-End Inventory = 184,646 Kg
- Safety Stock in 2023 is = 63,821 Kg
- Excess HCl Auxiliary Materials = Rp. 230,552,000

### Analysis

#### Results of Calculation of Final Inventory of Auxiliary Materials According to the Min-Max Stock Method for 2022-2023

Table 1 Final Supply of Auxiliary Materials for 2022-2023

Ingredient Name	Unit Name	2022	2023
Methanol	Kg	390.182	2.095.097
Catalist	Kg	1.130.654	1.776.481
NaOH	Kg	173.197	152.905
HCL	Kg	130.767	146.161

Based on the data above, it can be concluded that the largest final supply in 2023 is in Methanol auxiliary materials, which is 2,095,097 Kg. Meanwhile, in 2022, the largest final supply is in Catalist auxiliary materials, which is 1,130,654 Kg. Meanwhile, the smallest final supply in 2022 is in HCl auxiliary materials, which is 130,767 Kg, and the smallest final supply in 2023, namely in HCl auxiliary materials, which is 128,675 Kg.

Table 2 Results of Methanol Inventory Calculation by Min-Max Method

Methanol	Unit	2022	2023
<i>Safety Stock</i>	Kg	316.852	409.299
Minimum Inventory	Kg	1.790.862	1.808.862
Maximum Inventory	Kg	3.264.873	3.208.425
Reorder Rate	Kg	1.473.011	1.399.563

The data above shows that the reorder rate in 2022 is 1,473,011 Kg and in 2023 is 1,399,563 Kg. This shows that the condition of the supply of Methanol auxiliary materials in 2022 and 2023 is normal or there is no shortage of inventory.

Table 3 Results of Calculation of Catalist Inventory with Min-Max Stock

Catalist	Satuan	2022	2023
<i>Safety Stock</i>	Kg	76.325	92.518
Minimum Inventory	Kg	402.534	393.421
Maximum Inventory	Kg	728.743	695.324
Reorder Rate	Kg	326.209	301.903

The data above shows that the reorder rate in 2022 is 326,209 Kg and in 2023 is 301,903 Kg. This shows that the condition of the supply of Catalist auxiliary materials in 2022 and 2023 is below the minimum inventory but still above the safety stock limit and can still be overcome because it does not reach the state of zero stock so that in this situation it can still be said to be in a normal state or there is no shortage of inventory.

Table 4. Results of Calculation of NaOH Inventory with Min-Max Stock

NaOH	Satuan	2022	2023
<i>Safety Stock</i>	Kg	8.792	4.741
Minimum Inventory	Kg	22.629	19.923
Maximum Inventory	Kg	36.466	35.106
Reorder Rate	Kg	13.837	15.183

The data above shows that the reorder rate in 2022 is 13,837 Kg and in 2023 is 15,183 Kg. This shows that the condition in 2022 is slightly below the minimum inventory but can still be overcome so that the inventory of NaOH auxiliary materials in 2022 and 2023 is normal or there is no shortage of inventory.

Table 5. Results of HCl Inventory Calculation with Min-Max Stock Method

HCl	Satuan	2022	2023
<i>Safety Stock</i>	Kg	69.337	63.821
Minimum Inventory	Kg	276.169	268.125
Maximum Inventory	Kg	483.002	472.430
Reorder Rate	Kg	206.833	204.305

The data above shows that the reorder rate in 2022 is 206,833 Kg and in 2023 is 204,305 Kg. This shows that the condition of the supply of HCl raw materials in 2022 and 2023 is below the minimum inventory but still above the safety stock limit and can still be overcome because it has not reached the state of zero stock so that in this situation it can still be said to be in a normal state or there is no shortage of inventory.

#### Evaluation

Table 6. Results of Calculation of Final Excess Inventory Price with Min-Max Stock Method

Auxiliary Raw Materials	2022	2023
Methanol	Rp. 443.330.000	Rp. 10.283.367.800
Catalist	Rp. 7.907.467.500	Rp. 12.805.718.800
NaOH	Rp. 1.085.073.000	Rp. 1.022.331.600
HCl	Rp. 172.004.000	Rp. 230.552.000

Although the results of the calculation of the final supply of auxiliary materials do not experience a shortage, it should be noted that the supply of auxiliary materials is in excess and the above data shows a lot of excess costs invested in the storage of auxiliary materials inventory in the biodissipation process. This shows that the condition of the supply of auxiliary materials in 2022 and 2023 with catalist auxiliary materials in 2023 reaching the investment price for auxiliary materials of Rp. 12,805,718,800 is too much stored in the storage area, so in this situation it is detrimental for the company to invest too much in the supply of auxiliary materials.

#### 4. CONCLUSION

Based on the research that has been carried out, it can be concluded that, from the results of the research, the results of the final supply of auxiliary materials during 2022 and 2023 are very large compared to the calculation of inventory using the Min-Max Stock method. From the results of the study, it can be concluded that the control of the supply of auxiliary materials at PT. PHPO Belawan is still not optimal. The amount of final inventory of auxiliary materials is still very large and the largest is on Methanol Helper materials in 2023, Catalist in 2022 and 2023. So that too much is stored in the storage place, which in this situation is detrimental to the company to invest too much money in the supply of auxiliary materials.

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