International Journal Of Science, Engineering, and Information Technology
Volume 05, Issue 01, December 2020
Journal homepage https://Journal.trunojoyo.ac.id/ijseit

Application of the EOQ (Economic Order Quantity) Method in Determining Chemical Supplies in PT. Semen Indonesia

Hidayat[a], Moh.Jufriyanto[b], Akhmad Wasiur Rizqi[c], Rifky Maulana Yusron[d]

[abc]Depertment of Industrial Engineering, University of Muhammadiyah Gresik, Gresik, Indonesia.

[d]Department of Mechanical Engineering, University of Trunojoyo Madura, Bangkalan, Indonesia

A B S T R A C T

The competition among products has become commonplace in the industrial world in Indonesia. If the producers are unable to maintain the quality of the products they produce, there is a potential for decreasing consumer interest. PT. Semen Indonesia is a company with extraordinary development prospects. Quality control is needed in order to control the product so that when it arrives at the consumer the product is in its best condition, or when the product is still in process, production can be maximized. The method used in this research is Economic Order quantity (EOQ). Based on the resercah, the number of orders for each ingredient is for ammonium nitrate 1, barium chloride 1, ethanol 3, glycerol 1, hydrocloric acid 2, sodium hydroxide 3, strontium nitrate 2. Then, the ROP point or time to reorder each ingredient is for ammonium nitrate 2, barium chloride 4, ethanol 33, glycerol 16, hydrocloric acid 21, sodium hydroxide 4, strontium nitrate 13.

Keywords: EOQ (Economic Order Quantity), Chemical Supplies, PT.Semen Indonesia

Article history
Received 01 November 2020 Received in revised form 12 November 2020 Accepted 28 November 2020

1. Introduction

Currently competition among products has become commonplace in the industrial world in Indonesia. One of the factors that influence it is the emergence of new competitors, especially in terms of product quality that is continuously maintained. If the producers are unable to maintain the quality of the products they produce, there is a potential for decreasing consumer interest.

PT. Semen Indonesia is a company with extraordinary development prospects, as evidenced by only a few years, the Gresik plant has received many awards such as best effort and others. The high demand for cement has prompted PT Semen Indonesia's new plant to produce cement of the highest quality.

Quality control is needed in order to control the product so that when it arrives at the consumer the product is in its best condition, or when the product is still in process, production can be maximized. one way is to control the chemical compounds in the product. To do this, chemicals are needed that support the process, so that good chemical supply control is needed.

2. Literature Review

2.1 Logistics Management

The definition of logistics management is a strategic management process for the transfer and storage of goods, spare parts and finished goods from suppliers, between company facilities and to customers [1][2].

2.2 Logistics management objectives

The objective of logistics management is to repair finished goods and various materials in the right quantity at the right time at the time of need, the conditions that can be used, the location where it is needed and with the lowest total cost. Logistics provides time and place utility. This utility is an important aspect of the company's operations as well as the government [3].

logistic objectives have three objectives, namely:

1. Operational Objectives, so that the availability of goods and materials in the right quantity and adequate quality.
2. Financial objectives include the understanding that operational objectives can be accomplished at the lowest possible cost.
3. The purpose of security is to prevent the inventory from being disturbed by damage, waste, unauthorized use, theft and other improper depreciation.

2.3 Inventory

*Corresponding author
E-mail address : hidayat@umg.ac.id

E-ISSN 2548-4214

inventory is used as an unused resource. These unused resources have not been used because they are waiting for the process of production activities as found in the manufacturing system [4]. Marketing activities can be found in the distribution process or consumption activities such as in the household system.There are several types of inventory including raw material supplies, semi-finished materials and finished goods supplies [5]. Inventories of raw materials and semi-finished materials before being used / put / used into the production process are stored, while finished goods or merchandise inventories are stored before they are sold or marketed. Therefore companies and small businesses always provide or store raw materials [6].

2.4 EOQ (Economic Order Quantity)

Economic order quantity (EOQ) is the most economical amount of purchase, namely by making regular purchases of EOQ, the company will bear the minimal costs of procuring materials [7].

The purpose of this EOQ method is to determine the economic amount per order (EOQ) so as to estimate the total cost of supplies [8].

The simplest EOQ model has the following prerequisites and assumptions:

1. Only one item (product) is counted.
2. The need (demand) for each known period (certain).
3. The goods ordered are assumed to be immediately available (instaneously) or the production rate of the goods ordered (infinity).
4. The lead time is constant.
5. Each order is received in a single shipment and can be used immediately.
6. There are no back orders due to shortage.
7. There is no discount for the quantity purchased (quantity discount).

3. Research Method

After all the assumptions have been fulfilled, the following steps are commonly used to process EOQ data.

3.1 Determination of the Optimal Amount

To find the optimal number of orders in the EOQ method, you can use the following notation:

$Q = \sqrt{(2DS / h)}$

Where:

Q = economical order quantity

D = usage per year (in units)

S = Costs incurred each time orders are made

h = cost of saving per unit per period.

The total cost of inventory can use the following notation:

$BTP = D / Q\, S + Q / 2\, h$

Where:

BTP = Total Inventory Cost

Q = economical order quantity

D = usage per year (in units)

S = Costs incurred each time orders are made

h = cost of saving per unit per period

3.2 Determination of Safety Stock

Safety stock is an additional supply that is held to protect or maintain the possibility of material shortages (stock out). Safety stock aims to determine how much stock is needed during the grace period to meet the large demand. Safety stock can be calculated with the following formula:

$SS = Z\alpha \times \sigma \times \sqrt{LT}$

Where: SS = safety stock

$Z\alpha$ = Service level

σ = Standard Deviation

LT = lead time

3.3 Determination of the ROP (Reorder Point)

ROP is the limit / point of the number of re-orders including the requests that are wanted or needed during the grace period. With this ROP method, warehouse officers can find out when it is time to place an order for items that are running low. The ROP approach has the risk of stock out if the amount of demand during the lead time exceeds the amount of safety stock. Here is the formula for determining the reorder point:

$ROP = (d \times LT) + (Z\alpha \times \sigma \times \sqrt{LT})$

Where:

ROP = reorder point

d = daily requests

LT = lead time

$Z\alpha$ = Service level

σ = standard deviation of demand

4. Result and Discussion

The costs required in calculating the total cost of inventory are as follows:

4.1 Order Fee

Ordering costs are costs incurred in connection with ordering goods from the order of goods to their destination. In the process of ordering raw materials, communication tools are needed to contact suppliers, labor to carry out the order process, as well as order administration requirements for documentation in the form of an attached file. The cost of ordering each material based on the interview results requires the same details of costs and activities, so the cost of ordering each material is the same. The following is a breakdown of the costs included in the booking fee, including:

1. Telephone Fee

In placing an order, the time to make a call to the supplier from the interview results is estimated to take 15 minutes.

Phone fee = IDR 1375 per minute

Call time = 15 minutes

Total telephone charges = IDR 1375 x 15

= IDR 20,625 pe

2. Labor Costs ⅙

In the ordering process, workers are required to order raw materials and recap the administrative data for ordering materials. Based on the results of the interview, it takes 15 minutes to place an order and to recap the data for administration for 5 minutes.

Labor costs = IDR 3,871,052 / 160 hours

Labor time = 20 minutes

Total labor costs = IDR 403.23 x 20

= IDR 8064 per message

3. Administrative Costs

In the ordering process, there is a recap of the results of orders made in the form of an attached file. So that the administrative costs needed are only internet fees. Based on the results of the interview, the required internet requirement is 500kb per message.

4. Internet fee = IDR 652,000 / month (300GB)

Internet requirement = 1500 kb

Total internet fees = IDR 0.002173 x 1500

= IDR 3.3

Total ordering costs = Telephone costs + labor costs + administration costs

= IDR 20,625 + IDR 8064

+ IDR 3,3

= IDR 28,692

4.2 Storage Costs

Storage costs are costs incurred as a result of stored raw materials. In general, storage costs consist of utility costs such as electricity from ordering, capital costs in the form of alternative income for funds invested in inventory costs. Capital costs from inventory investment will be added to get storage costs expressed as product value.

The interest rate used is the BCA bank interest rate in 2019 of 5.5% per month. As well as the cost per Kwh for electricity in 2019 of IDR. 1114.74, - / Kwh.

For storage of all materials (ammonium nitrate, Barium chloride GRA, Ethanol, Glycerol, Hydrocloric Acid 37 GR, Sodium hydroxides pellets GR, strontium nitrate) are placed in the same warehouse so that labor costs and warehouse lighting costs will be divided by the number of raw materials available in the warehouse.

The calculation of the fraction of the storage cost of each of these three ingredients is:

The interest rate in May 2019 is 5.5%, so the opportunity cost of storing materials is 5.5%

Warehouse operational costs include:

4.3 Labor costs

Employee working hours for operations at 13.00-17.00 per day. but employees do not stay put all the time.

1 employee = IDR 3,871,052.00 / month

Total labor costs = 0.25% x IDR 3,871,052.00

= IDR 967,763.00 / month

4.4 Warehouse lighting and cooling costs

The company uses 8 lamps with 12 watts of power for warehouse lighting, which is assumed to be 22 days per month for 3 hours / day. So that the costs for warehouse lighting are as follows:

Warehouse lighting

8 lamps x 12 watts x 3 hours x 22 days

= 6336 wh = 6.36 kwh

Warehouse room cooler, AC 1 PK

1 AC x 660 watts x 9 hours x 30 days

= 178,200 wh = 178.2 kwh

Operating costs

= (6.36 kwh + 178.2 kwh) x IDR. 1,114.74

= IDR 205,599 / month

The calculation of the percentage of costs arising from storage will be divided by the average amount of raw materials per week multiplied by the price of raw materials then the result is multiplied by 100%. So that the percentage fraction of the storage cost for the three raw materials is:

Ammonium nitrate raw material

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR 205,599 + IDR 967,763) / (28 x IDR 1,547,000) x 100%

= 2.70%

So the fraction of the storage cost for ammonium nitrate is:

Fraction of saving costs = Opportunity cost + warehouse operating costs

= 5.5% + 2.70%

= 8.20%

Barium chloride GRA raw material

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR 205,599 + IDR 967,763) / (8 x IDR 938,000) x 100%

= 15.59%

So the fraction of the storage cost for clinker raw materials is as large as:

Storage cost fraction = Opportunity cost + warehouse operational costs

= 5.5% + 15.59%

= 21.09%

Ethanol raw material

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR 205,599 + IDR 966,968) / (22 x IDR 1,170,000) x 100%

= 4.55%

Fraction of saving costs = Opportunity cost + warehouse operating costs

Glycerol raw material

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR. 205,599 + IDR. 967,763) / (60 x IDR. 5,683,000) x 100%

= 0.35%

So the fraction of the storage cost for clinker raw materials is as large as:

Fraction of saving costs = Opportunity cost + warehouse operating costs

= 5.5% + 0.35%

= 5.85%

Hydrocloric Acid raw material 37 GR

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR 205,599 + IDR 967,763) / (8 x IDR 1,500,000) x 100%

= 9.75%

So the fraction of the storage cost for clinker raw materials is as large as:

Fraction of saving costs = Opportunity cost + warehouse operating costs

= 5.5% + 9.75%

= 15.25%

Sodium hydroxides pellets raw material GR

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR 205,599 + IDR 967,763) / (14 x IDR 492,750) x 100%

= 16.95%

So the fraction of the storage cost for clinker raw materials is as large as:

Fraction of saving costs = Opportunity cost + warehouse operating costs

= 5.5% + 16.95%

= 22.45%

Strontium nitrate raw material

= (Operating costs + Labor costs) / (Average storage x raw material prices) x 100%

= (IDR 205,599 + IDR 967,763) / (10 x IDR 1,420,000) x 100%

= 8.24%

So the fraction of the storage cost for clinker raw materials is as large as:

Fraction of saving costs = Opportunity cost + warehouse operating costs

= 5.5% + 8.24%

= 13.74%

4.5 Data processing

After collecting the data, the collected data will be processed to determine the optimal number of orders, and to control the right

Table 1. Determination of the Number of EOQ

Item name	Demand (year)	Price (IDR)	Order Cost (IDR)	Storage Cost (unit) (IDR)	EOQ
Ammonium nitrate	1	1.554.000	27.600	145.654	1
Barrium chloride GRA	2	885.000	27.600	186.112	1
Ethanol	24	1.240.000	27.600	128.458	3
Glycerol	11	6.260.000	27.600	342.656	1
HYDROCLORIC ACID 37% GR	15	1.400.000	27.600	320.750	2
SODIUM hydroxides pellets GR	2	692.850	27.600	16.072	3
strontium nitrate	9	1.320.000	27.600	185.106	2

Based on the table 1, it is known that the optimal amount of material ordering every time you place an order for materials based on the EOQ method.

4.7 Determination of Safety Stock

The safety stock for each material used is to add 1 ingredient for each type of material because each material ordering takes 6 months so that when in the process of ordering materials there will be no running out of ingredients.

Table 2. Determination of Amount of ROP

Item name	Demand (unit/month)	Lead Time (month)	Safety Stock	ROP
ammonium nitrate	0,0733	6	1	2
barrium chloride GRA	0,1777	6	1	2
Ethanol	2	6	14	24
Glycerol	0,9167	6	6.5	11
HYDROCLORIC ACID 37% GR	1,36	6	8.5	15
SODIUM hydroxides pellets GR	0,267	6	1	2
strontium nitrate	0,65	6	5.5	9

Based on the table 2, it is known that the ROP (Reorder Point) point of each material is as shown in the table. ROP is obtained from the multiplication of demand and lead time then added with the safety stock.

5. Conclusions and Suggestionts

5.1 Conclusion

Based on the research results it can be concluded that:

1. The number of orders for each ingredient is for ammonium nitrate 1, barium chloride 1, ethanol 3, glycerol 1, hydrocloric acid 2, sodium hydroxide 3, strontium nitrate 2.

2. The ROP point or time to reorder each ingredient is for ammonium nitrate 2, barium chloride 4, ethanol 33, glycerol 16, hydrocloric acid 21, sodium hydroxide 4, strontium nitrate 13.

5.2 Suggestion

The company (PT. Semen Indonesia) as a place of research is expected to consider the suggestions given by implementing policies in accordance with the results of observations made, with the aim of being able to provide benefits in the future.

REFERENCES

[1] E. M. B. Aske and S. Skogestad, "Consistent inventory control," Industrial & Engineering Chemical Research, vol. 48, no. 24, pp. 10892–10902, 2009. https://doi.org/10.1021/ie801603j.

[2] R. Chaib, M. L. Bouanaka, A. Bellaouar, M. Benidir, and I. Verzea, "Determination of the efficiency of a means of production application in a chain of production," Management of Technological Changes, vol. 1, pp. 605–608, 2009.

[3] A. Bacchetti, R. Plebani, N. Saccani, and A. Syntetos, "Spare Parts Classification and Inventory Management: a Case Study," Salford Business School Working Papers Series, vol. 408, 2010.

[4] M. Godichaud and L. Amodeo, "Economic order quantity for multistage disassembly systems," International Journal of Production Economics, vol. 199, pp. 16–25, 2018. https://doi.org/10.1016/j.ijpe.2018.02.008.

[5] R. Kumar, "Economic Order Quantity (EOQ) Model," Global Journal of Finance and Economic Management, vol. 5, no. 1, pp. 2249–3158, 2016.

[6] L. B. Schwarz, "The economic order-quantity (EOQ) model," International Series in Operations Research and Management Science, vol. 115, 2008, pp. 135–154. https://doi.org/10.1007/978-0-387-73699-0_8.

[7] C. C. Defee, B. Williams, W. S. Randall, and R. Thomas, "An inventory of theory in logistics and SCM research," The International Journal of Logistics Management, vol. 21(3), pp. 404-489, 2010. https://doi.org/10.1108/09574091011089817.

[8] E. Van Der Laan, M. Salomon, R. Dekker, and L. Van Wassenhove, "Inventory control in hybrid systems with remanufacturing," Management Science, vol. 45(5), pp. 733-747, 1999. https://doi.org/10.1287/mnsc.45.5.733.