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Analysis of Chlorine Inventory Using the Economic Order Quantity (EOQ) Method (Case Study of PT. Toya Indo Manunggal)

Nirmala Putri[1], Ade Momon[2]
[1,2] Program Studi Teknik Industri Fakultas Teknik Universitas Singaperbangsa Karawang
Email: nirmalaputri710@gmail.com

ABSTRACT

The purpose of this study was to determine the frequency of ordering chlorine for one year at PT. Toya Indo Manunggal using the Economic Order Quantity (EOQ) method, to determine the cost of chlorine supplies of PT. Toya Indo Manunggal with the Economic Order Quantity (EOQ) method, as well as to analyze the results of the application of the Economic Order Quantity (EOQ) method. The research method used in this study is the economic order quantity (EOQ) model. Data collection techniques are used to collect data according to research procedures so that the required data is obtained. The data used is secondary data in the form of literature studies, namely conducting literature research by reading and researching materials or theories related to chlorine supplies, and Economic Order Quantity (EOQ). The results showed that the frequency of ordering chlorine for one year at PT. Toya Indo Manunggal uses the Economic Order Quantity (EOQ) method of 112 chlorine cylinders per order with a total of 13 orders in one year, the distance between times reaches 20 days per order, and the company must provide security storage or Safety Stock of 142 chlorine cylinders with goods reorder activities when the inventory of the goods is 178 pcs. From data analysis, the total cost of inventory using the EOQ method is Rp. 940,802,000, while the total cost of inventory with orders above and below EOQ is Rp. 1,034,137,777 and Rp. 985,012,631, respectively. Every order for goods above or below the EOQ order will affect the cost of inventory, where the cost of inventory that occurs is greater than the cost of EOQ inventory. With the Economic Order Quantity (EOQ) method, companies can find out how many orders are economical for each inventory item and find out the frequency of orders during a period and when orders are made again, so that the demand for goods can be fulfilled optimally.

Keywords: chlorine supplies, EOQ method, PT. Toya Indo Manunggal

Introduction

According to Widayanto (2012)*Supply Chain Management* It is an approach to optimize the integration between suppliers, manufacturing, warehouses and storage, so that the production and distribution of goods can be carried out in the right quantity, the right location, the right price and minimize costs and provide service satisfaction to consumers. In today's era, consumer demands on product quality, price, delivery accuracy and product availability on the market are getting higher. Therefore, industry players and business people need to implement more integrated management so that activities carried out in certain industries and businesses can run effectively and efficiently. The development of the business world is experiencing such fierce competition. In winning the competition, the company uses various methods or methods, including by increasing customer satisfaction through quality products, delivery timeliness, and cost efficiency.

In a company, it must not be separated from the problem of stock of goods. The process of recording a large stock of goods sometimes makes a company need more time in the calculation process. Especially with the purchase of a lot of goods and the fast distribution of goods, it definitely takes time to record every item that enters and exits. A production plan will run well if it is supported by an adequate supply of raw materials. On the other hand, the supply of raw materials also contributes a considerable amount of costs so that this cost component also needs to be controlled. Seeing the importance of the industrial planning and inventory control functions above, it is necessary to make efforts to manage it efficiently to get optimal results. To forecast the stock of goods that must be provided in this study using the EOQ *(Economic Order Quantity)* method. One of the calculations used in determining the quantity of the company's raw material order. In simple theory, EOQ only applies when the rate *of demand*, ordering *cost*, and purchasing *unit price* are constant. Planning an EOQ model in the company will be able to minimize the occurrence of *out-of-stock*, reduce storage costs, and save space.

PT. Toya Indo Manunggal is a company engaged in the field of *stockists* and *suppliers* for chemical needs. PT. Toya Indo Manunggal is one of the companies in Karawang that is *a supplier* of chemicals for several factories in various cities. The company is having trouble in terms of chlorine inventory. The factor that is the cause is the calculation of chlorine units only based on the logic of the warehouse manager. Without conducting

a detailed analysis. With this, the solution that can be provided is to manage inventory using the *Economic Order Quantity* method. This method calculates the units that must be provided by the company in ordering chlorine for consumer needs.

Research Methods

According to Gitosudarmo quoted by Puspika, EOQ analysis is an analysis used to determine the most economical volume or number of purchases each time a Method is purchased. EOQ strives to achieve the lowest possible level of inventory, low cost, and better quality. Planning with the EOQ method will be able to minimize the occurrence of out of stock so that it does not interfere with the company's production process due to the efficiency of raw material inventory in the company concerned. In addition, with the implementation of the EOQ method, the company will be able to reduce storage costs, save space for the warehouse, and problems arising from the large amount of inventory that accumulates, thereby reducing the risks that can arise due to the inventory in the warehouse. Meanwhile, according to Fahmi, the economic order quantity (EOQ) model is a mathematical model that determines the number of goods that must be ordered to meet projected demand with minimized inventory costs. EOQ is one of the methods in inventory that aims to determine the most economical order quantity of a good or material. The use of the EOQ method can improve cost efficiency, so that the company can save production costs. (2002) (2013)(2012)(Sirait, 2013)

Results and Discussion

The analysis of this practical work report was carried out at PT. Toya Indo Manunggal (Cikampek branch) located on JL. Raya Jakarta-Cirebon KM 100, Dsn Kiara, North Pangulah, Kotabaru, Karawang, West Java. Inventory is important for the company, If the company has too large inventory, then a lot of idle funds are invested in inventory. On the other hand, if the inventory is too small to save inventory costs, then the company is threatened to run out of *stock* one day when there is a surge in demand for inventory, then the company must make inventory with optimal value, where the value of the inventory is not too small so that it can still support the smooth sales process and is also not too large so that the company does not incur costs which is too much. The company must also pay attention to the amount of the final balance of the inventory whether it includes safety stock to avoid the company running out of stock and determine the reorder *point* so that the arrival of the ordered inventory is right when the inventory is at *the expected* level of Safety Stock.

With these problems, companies often experience delays in delivery and also cause significant losses for both the executor and the owner of the company. This research was carried out to find out how many economical orders for chlorine stock goods and to find out the frequency of orders for a period and when goods orders are made again, so that the demand for goods can be met optimally. The data used is secondary data obtained from PT. Toya Indo Manunggal. Below are the order data, storage data and chlorine goods data in 2021.

Table 1. Chlorine Data

No	Bulan	Agen	Total
		Palija	
1	Januari	128	128
2	Februari	120	120
3	Maret	128	128
4	April	128	128
5	Mei	120	120
6	Juni	128	128
7	Juli	120	120
8	Agustus	128	128
9	September	120	120
10	Oktober	128	128
11	November	128	128
12	Desember	128	128
Total			**1504**

The following are the results of data processing from research at PT. Toya Indo Manunggal.

1. Determination of the Number of Goods Ordered

a. Calculation of the *Economic Order Quantity* (EOQ) Method
The calculation of the EOQ method consists of the number of goods, the order fee, and the storage fee. The following is the formula used in the calculation of the EOQ Method.

$$Q^* = \sqrt{\frac{2DS}{H}}$$

Information:
Q^* = Symbol of EOQ
D = Demand or annual demand
S = Booking fee per year
H = Storage costs per year

In this study, the data taken is chlorine inventory data in 2021. Beriku is demand data, storage data and chlorine order data that have been recapitulated.

Table 2. Chlorine Demand and Cost Data

Data Permintaan (D)	Biaya Pemesanan (S)	Biaya Penyimpanan (H)
1504	Rp 35.030.000,00	Rp 8.400.000,00

Source: (PT. Toya Indo Manunggal)

From the data in the table above, the number of economic orders can be calculated as follows:

$$Q^* = \sqrt{\frac{2DS}{H}}$$

$$Q^* = \sqrt{\frac{2 \times 1504 \times 35.030.000}{8.400.000}}$$

$$Q^* = \sqrt{12.612,114285714}$$

$$Q^* = 112,09$$

From the calculations, it was found that the optimal amount of chlorine ordered every time an order was placed in the 2022 period was 112 units rounded to 112 per chlorine order.

b. Frequency of Orders for 2022
The frequency of chlorine orders in 1 period can be found by calculating the number of goods needed and the results of the EOQ calculation. The following is the formula used in the frequency of ordering chlorine goods in 2022.

$$n = \frac{D}{Q^*}$$

Information:
n = Number of orders in a year
D = *Demand* per year
Q^* = Optimal total bookings
As the data has been known above, the number of chlorine orders in 2022 can be calculated as follows:

$$n = \frac{D}{Q^*}$$

$$n = \frac{1504}{112}$$

$$n = 13,42$$

The frequency of chlorine orders that can be made during the 2022 period is 13.42 times, rounded up to 13 orders in one year.

c. Booking time interval
The calculation of the number of days in a year can be done using the formula:
52 weeks x 5 (number of working days in a week) = 260 working days over the course of a year.
The booking time interval can be calculated using the following formula:

$$T = \frac{Jumlah\ hari\ kerja/thn}{n}$$

Information:
T = Total distance between booking times
n = Total optimal booking frequency
If it is assumed that 1 year consists of 260 days, then the period between each order is:

$$T = \frac{Jumlah\ hari\ kerja/thn}{n}$$

$$T = \frac{260}{13}$$

$$T = 20\ hari$$

So the distance between each chlorine order during the 2022 period is 20 days.

2. Inventory Costs
   a. *Inventory Total Cost* (TC)
   Based on the results of the EOQ calculation above, the inventory cost can be determined, as follows:

$$TC = \left(\frac{Q^*}{2}H\right) + \left(\frac{D}{Q^*}S\right)$$

$$TC = \left(\frac{112}{2}8.400.000\right) + \left(\frac{1504}{112}35.030.000\right)$$

$$TC = (470.400.000) + (470.402.000)$$

$$TC = Rp.940.802.000$$

   The inventory cost incurred for chlorine for the 2022 period is Rp. 940,802,000
3. Safety *Stock*
   To determine the amount of safety stock, it can be calculated using the formula:

$$SS = SD \times Z$$

   Information:
   SS = Safety Stock or security supplies
   SD = Standard Deviation
   Z = Standard Deviation
   In the calculation of safety stock this time, the results of the standard deviation are injured, the following are the results of the standard deviation calculation.

Table 3. Standard Deviation Calculation

No	Bulan	Unit	Perkiraan	Deviasi	Kuadrat
		X	Y	(X-Y)	$(X-Y)^2$
1	Januari	128	140	-12	154
2	Februari	120	155	-35	1259
3	Maret	128	171	-43	1812
4	April	128	186	-58	3322
5	Mei	120	201	-81	6515
6	Juni	128	216	-88	7708
7	Juli	120	231	-111	12293
8	Agustus	128	246	-118	13912
9	September	120	261	-141	19888
10	Oktober	128	276	-148	21934
11	November	128	291	-163	26628
12	Desember	128	306	-178	31775
Jumlah		1504	2680	-1176	147201
Rata-rata		125,333	223	-98	12267
Standar Deviasi		110,755			

After the standard deviation is known, with the assumption that PT. Toya Indo Manunggal implements inventory to be able to meet consumer demand (*service level*) which is 90%, so that Z can be obtained with a normal table of 1.28. So that the safety stock obtained is:

$$SS = SD \times Z$$

$$SS = 110{,}755 \times 1{,}28$$

$$SS = 141{,}989$$

The storage of safety *stock* needed by the company before reordering is 141,989 chlorine cylinders rounded up to 142 chlorine cylinders.

4. *Reorder Point* (ROP)

In this study, the *lead time* needed to order goods until the goods arrive is 5 days, and *the safety stock* has been determined at 142 chlorine tubes. Assuming a working time of 260 days in a year.
The calculation of Reorder points can be calculated using the following formula:

$$\text{ROP} = SS + \left(\frac{D}{\text{jumlah } hari\ kerja\ per\ tahun}\right) \times Lt$$

Information
ROP = total inventory of goods when the order will be reordered.
SS = security supplies.
D = request data.
Lt = Lead Time or waiting time for orders to be shipped after an order has been placed.
The following is the calculation of the Reorder point of chlorine goods at PT. Toya Indo Manunggal.

$$ROP = SS + \left(\frac{D}{jumlah\ hari\ kerja\ per\ tahun}\right) \times Lt$$

$$ROP = 142 + \left(\frac{1504}{260}\right) \times 5$$

$$ROP = 142 + 7{,}300 \times 5$$

$$ROP = 178{,}50$$

The result of the calculation of the reorder point is 178.50 which is rounded to 178 chlorine tubes, therefore in this period the activity of reordering goods at the time of inventory of the goods is 178 pcs.
Recapitulation of the results of the calculation of the EOQ Method with the demand demand of 1504 chlorine tubes

Table 4. Recapitulation of the Results of the EOQ Method Calculation

Tahun	**EOQ**	**n**	**T**	**TC**	**SS**	**ROP**
2022	112	13	20	Rp 940.802.000,00	142	178

Source: (Penulis, 2022)

5. Inventory Cost Comparison
   a. Inventory costs if below EOQ
      Assuming that the inventory if PT. Toya Indo Manunggal has the following chlorine supplies:

Table 5. Data Assumptions and Chlorine Supply Costs under EOQ

Data Permintaan (D)	Biaya Pemesanan (S)	Biaya Penyimpanan (H)
72	Rp 35.030.000,00	Rp 8.400.000,00

Source: (Penulis, 2022)

Assuming the EOQ inventory is reduced by 40 units, then the calculation of inventory costs on chlorine orders is as follows:

$$TC = \left(\frac{Q^*}{2}H\right) + \left(\frac{D}{Q^*}S\right)$$

$$TC = \left(\frac{72}{2}8.400.000\right) + \left(\frac{1504}{72}35.030.000\right)$$

$$TC = (302.400.000) + (731.737.777)$$

$$TC = Rp.\,1.034.137.777$$

The inventory cost incurred for chlorine for the 2022 period if the demand is increased by EOQ is Rp. 1,034,137,777.

   b. Inventory costs if above EOQ
      Assuming that the inventory if PT. Toya Indo Manunggal has the following chlorine supplies:

Table 6. Assumption of Chlorine Supply Data and Cost above EOQ

Data Permintaan (D)	Biaya Pemesanan (S)	Biaya Penyimpanan (H)
152	Rp 35.030.000,00	Rp 8.400.000,00

Source: (Penulis, 2022)

Assuming the EOQ inventory is added to 40 units, then the calculation of the inventory cost on the chlorine order is as follows:

$$TC = \left(\frac{Q^*}{2}H\right) + \left(\frac{D}{Q^*}S\right)$$

$$TC = \left(\frac{152}{2}8.400.000\right) + \left(\frac{1504}{152}35.030.000\right)$$

$$TC = (638.400.000) + (346.612.631)$$
$$TC = Rp.985.012.631$$

The inventory cost incurred for chlorine for the 2022 period if the demand is above EOQ is Rp. 985,012,631

The comparative recapitulation between inventory costs that have been calculated using the EOQ method, data below EOQ and data above EOQ can be described in the following table:

Table 7. Recapitulation of Inventory Cost Comparison

Item	EOQ	< EOQ	> EOQ
Klorin	Rp 940.802.000,00	1.034.137.777.	Rp 985.012.631,00

Source: (Penulis, 2022)

From the data above, it can be seen that the calculation of inventory costs using the *Economic Order Quantity* (EOQ) method is lower than the inventory cost of *Economic Order Quantity & Inventory Cost* by ordering inventory of goods above or below the EOQ order, therefore using the EOQ method will minimize inventory cost expenses. The total cost incurred to obtain goods can also be used as efficiently as possible and avoid the occurrence of accumulated inventory and anticipate shortages of inventory.

Conclusion

The conclusion that can be drawn from this study is the frequency of chlorine orders for one year at PT. Toya Indo Manunggal uses the *Economic Order Quantity* (EOQ) method of 112 chlorine cylinders per order with a total of 13 orders in one year, the interval between times reaches 20 days each order, and the company must provide secure storage or *Safety Stock* of 142 chlorine cylinders with the activity of reordering goods at the time of inventory of the goods of 178 pcs. From the data analysis, the total inventory costs using the EOQ method are Rp. 940,802,000, while the total inventory costs with orders above and below EOQ are Rp. 1,034,137,777 and Rp. 985,012,631, respectively. Every time you place an order for goods above or below the EOQ order will affect the inventory cost, where the inventory cost that occurs is greater than the EOQ inventory cost. With the *Economic Order Quantity* (EOQ) Method, companies can find out how many economical orders are for each inventory item and find out the frequency of orders for a period and when goods are ordered again, so that the demand for goods can be fulfilled optimally.

Reference

[1] Adi, E. W. (2012). Analysis of the Bank's Health and Financial Performance Using the CAMEL Method. *EKSIS Journal, Vol 8 No.2.* .
[2] Adiwisastra, A. (1989). *Sources, Dangers and Poisoning Countermeasures.* Bandung: Angkasa.
[3] Anita, D. &. (2013). Inventory Control and Inventory Planning of Raw Materials for Bread Production at the Bobo Bread Factory Pekanbaru. *Journal of Economics, University of Riau*.
[4] Assauri, S. (2004). *Production and Operations Management.* (Revised Edition, ed.). Jakarta: FE-UI Publishing Institution.
[5] Danang, S. (2013). *Accounting Research Methodology.* Bandung: PT Refika Aditama Member of Ikapi.
[6] Delmar, D. (1985). *Operation and Industrial Management Designing and Managing for Productivity.* United States of America:: Mc.Graw-Hill Book Company.
[7] Edwin and Chris. (1999). *Marketing Communication, Contexts, Content and Strategies.* Singapore: Prectice Hall.
[8] Ely Suhayati, S. D. (2009). *Financial Accounting,* (First Edition ed.). Yogyakarta: Graha Ilmu.
[9] Fahmi, I. (2012). *"Financial Performance Analysis".* Bandung: Alfabeta.
[10] Gitosudarmo, I. (2002). *Financial Management Edition 4.* Yogyakarta: BPFE.
[11] Haizer, J. &. (2001). *Principles of Operations Management.* Jakarta: Salemba Four.
[12] Haming, M. d. (2012). *Modern Production Management* (2nd Edition, Book 2, ed.). Jakarta: Bumi Aksara.
[13] Heizer and Render. (2014). *Operations Management.* Jakarta: Selemba Four.
[14] Heizer Jay, R. B. (2005). *Operations Management.* . . Jakarta: Salemba Four.
[15] Heizer, J. &. (2011). *Operations Management.* (Ninth ed.). (C. Sungkono, Trans.) Jakarta: Salemba Four.
[16] Imam Santoso. (2010). *"Intermediate Accounting".* Bandung: PT. Refika Aditama,.
[17] Kotler, P. (2002). *Marketing Management,* (Millennium Edition, Volume 2 ed.). Jakarta: PT Prenhallindo.

[18] Kusuma, H. (2009). *Production Management, Production Planning and Control* (Fourth Edition ed.). Yogyakarta: Publisher And.
[19] Margaretha, F. (2011). *Theory and Application of Investment Financial Management and Short-Term Sources of Funds.* Jakarta: Grasindo Gramedia Widiasarana Indonesia.
[20] Nafarin. (2000). *"Corporate Budgeting".* Jakarta: Salemba Four.
[21] Nafarin, M. (2007). *Company Budgeting.* Salemba Four: Salemba Four.
[22] Pudjianto, R. (1984). *Guidelines for Shrimp Pond Cultivation.* Jakarta: Director General of Agriculture.
[23] Purnomo Hari. (2004). *"Introduction to Industrial Engineering".* Yogyakarta: Graha Ilmu.
[24] Rangkuti, F. (1995). *Application Inventory Management in the field of Business, .* Jakarta: Management of PT Raja Grafindo Persada,.
[25] Rangkuti., F. (2007). *Inventory Management: Applications in the Business Field.* (2nd ed.). Jakarta: PT. King Grafindo Persada.
[26] Riyanto, B. (2008). *Basics of Corporate Spending.* Yogyakarta: BPFE-Yogyakarta.
[27] Sinuhaji, D. N. (2009). Differences in Chlorine (Cl2) Content in Rice Before and After Cooking.
[28] Sirait, H. B. (2013). Planning for Raw Material Inventory Control Using the Economic Order Quantity Model (Case Study: PT. XYZ). *Science of Mathematics, Vol. 1*.
[29] Stevenson, W. C. (2014). *Operations Management Asian Perspective* (9th Edition, ed.). Jakarta: Salemba Empat and MC Graw Hill Education.
[30] Sugiyono. (2014). *Educational Research Methods, Quantitative Approaches, and R&D.* Bandung: Alfabeta.
[31] Toya Indo Manunggal. (2022). Karawang.
[32] Utari, D. d. (2014). *Financial Management: A Study of Practice and Theory in Managing Corporate Organizational Finance.* Jakarta: Mitra Wacana Media.
[33] Warman, J. (1971). *Warehouse Management.* Jakarta: Pustaka Sinar Harapan/ London: William Heinemann Ltd.
[34] Warman, J. (2012). *"Warehousing Management"* (Seventh ed.). Jakarta: PT Puka Sinar Harapan.
[35] Yamit, Z. (2003). *"Production and Operations Management"* (Second ed. ed.). Yogyakarta: FE UII.