

LAMPIRAN

Lampiran 1

Pengendalian Persediaan dengan Metode Min-Max

Berikut adalah informasi pemesanan bahan baku pupuk NPK Phonska selama 2023:

Jenis Bahan Baku	Total Pemesanan (ton)	Rata-Rata Pemesanan (ton)	Max Pemesanan (ton)	Min Pemesanan (ton)
Amoniak	162.785,40	13.565,45	23.483,53	5.550,99
Asam Sulfat	360.609,33	30.050,78	51.939,55	13.198,27
Asam Fosfat	367.154,37	30.596,20	46.287,97	18.490,81
KCl Merah	306.237,87	25.519,82	45.257,97	14.004,88

1. Asam Sulfat

- *Safety Stock*

$$SS = ((\text{pemesanan maks.}) - (\text{rata" pemesanan})) \times LT$$

Maka,

$$SS = ((51.939,55 \text{ ton}) - (30.050,78 \text{ ton})) \times$$

0,43 bulan

$$= 9.485,13 \text{ ton}$$

- **Minimum Stock**

$$\text{Min. Stock} = (\text{rata" pemesanan} \times \text{LT}) + \text{SS}$$

Maka,

$$\begin{aligned} \text{Min. Stock} &= (30.050,78 \text{ ton} \times 0,43 \text{ bulan}) + \\ &9.485,13 \text{ ton} \\ &= 22.507,14 \text{ ton} \end{aligned}$$

- **Maximum Stock**

$$\text{Max. Stock} = 2 \times (\text{rata" pemesanan} \times \text{LT}) + \text{SS}$$

Maka,

$$\begin{aligned} \text{Max. Stock} &= 2 \times (30.050,78 \text{ ton} \times 0,43 \text{ bulan}) + \\ &9.485,13 \text{ ton} \\ &= 35.529,14 \text{ ton} \end{aligned}$$

- **Q (Kuantitas Pemesanan)**

$$Q = \text{Maximum Stock} - \text{Minimum Stock}$$

Maka,

$$\begin{aligned} Q &= 35.529,14 \text{ ton} - 22.507,14 \text{ ton} \\ &= 13.022,00 \text{ ton} \end{aligned}$$

- **Q Lot**

$$Q \text{ Lot} = \frac{Q}{\text{kapasitas muat kapal}}$$

Maka,

$$\begin{aligned}
 Q \text{ Lot} &= 13.022,00 \text{ ton} / 20.000 \text{ ton} \\
 &= 0,65 \approx 1 \text{ unit kapal}
 \end{aligned}$$

- **Frekuensi Pemesanan**

$$\text{Frekuensi Pemesanan} = \frac{\text{Total Pemesanan}}{Q}$$

Maka,

$$\begin{aligned}
 \text{Frekuensi Pemesanan} &= 360.609,33 \text{ ton} / \\
 &13.022,00 \text{ ton} \\
 &= 27,7 \approx 28 \text{ kali}
 \end{aligned}$$

- **Re-Order Point**

$$\begin{aligned}
 \text{ROP} &= \text{Min. Stock} \\
 &= 35.529,14 \text{ ton}
 \end{aligned}$$

2. Asam Fosfat

- **Safety Stock**

$$SS = ((\text{pemesanan maks.}) - (\text{rata" pemesanan})) \times LT$$

Maka,

$$\begin{aligned}
 SS &= ((46.287,97 \text{ ton}) - (30.596,20 \text{ ton})) \times \\
 &1,00 \text{ bulan} \\
 &= 15.691,77 \text{ ton}
 \end{aligned}$$

- **Minimum Stock**

$$\text{Min. Stock} = (\text{rata" pemesanan} \times LT) + SS$$

Maka,

$$\begin{aligned}\text{Min. Stock} &= (30.596,20 \text{ ton} \times 1,00 \text{ bulan}) + \\ &15.691,77 \text{ ton} \\ &= 46.287,97 \text{ ton}\end{aligned}$$

- **Maximum Stock**

$$\text{Max. Stock} = 2 \times (\text{rata}^{\text{a}} \text{ pemesanan} \times \text{LT}) + \text{SS}$$

Maka,

$$\begin{aligned}\text{Max. Stock} &= 2 \times (30.596,20 \text{ ton} \times 1,00 \text{ bulan}) + \\ &15.691,77 \text{ ton} \\ &= 76.884,17 \text{ ton}\end{aligned}$$

- **Q (Kuantitas Pemesanan)**

$$Q = \text{Maximum Stock} - \text{Minimum Stock}$$

Maka,

$$\begin{aligned}Q &= 76.884,17 \text{ ton} - 46.287,97 \text{ ton} \\ &= 30.596,20 \text{ ton}\end{aligned}$$

- **Q Lot**

$$Q \text{ Lot} = \frac{Q}{\text{kapasitas muat kapal}}$$

Maka,

$$\begin{aligned}Q \text{ Lot} &= 30.596,20 \text{ ton} / 10.000 \text{ ton} \\ &= 3,06 \approx 4 \text{ unit kapal}\end{aligned}$$

- **Frekuensi Pemesanan**

$$\text{Frekuensi Pemesanan} = \frac{\text{Total Pemesanan}}{Q}$$

Maka,

$$\begin{aligned} \text{Frekuensi Pemesanan} &= \frac{367.154,37 \text{ ton}}{30.596,20 \text{ ton}} \\ &= 12 \text{ kali} \end{aligned}$$

- **Re-Order Point**

$$\begin{aligned} \text{ROP} &= \text{Min. Stock} \\ &= 46.287,97 \text{ ton} \end{aligned}$$

3. KCL Merah

- **Safety Stock**

$$SS = ((\text{pemesanan maks.}) - (\text{rata" pemesanan})) \times LT$$

Maka,

$$\begin{aligned} SS &= ((45.257,97 \text{ ton}) - (14.004,88 \text{ ton})) \times 0,73 \text{ bulan} \\ &= 14.474,64 \text{ ton} \end{aligned}$$

- **Minimum Stock**

$$\text{Min. Stock} = (\text{rata" pemesanan} \times LT) + SS$$

Maka,

$$\begin{aligned} \text{Min. Stock} &= (25.519,82 \text{ ton} \times 0,73 \text{ bulan}) + 14.474,64 \text{ ton} \end{aligned}$$

$$= 33.189,18 \text{ ton}$$

- **Maximum Stock**

$$\text{Max. Stock} = 2 \times (\text{rata}'' \text{ pemesanan} \times \text{LT}) + \text{SS}$$

Maka,

$$\text{Max. Stock} = 2 \times (25.519,82 \text{ ton} \times 0,73 \text{ bulan}) + 14.474,64 \text{ ton}$$

$$= 51.903,72 \text{ ton}$$

- **Q (Kuantitas Pemesanan)**

$$Q = \text{Maximum Stock} - \text{Minimum Stock}$$

Maka,

$$Q = 51.903,72 \text{ ton} - 33.189,18 \text{ ton} \\ = 18.714,54 \text{ ton}$$

- **Q Lot**

$$Q \text{ Lot} = \frac{Q}{\text{kapasitas muat kapal}}$$

Maka,

$$Q \text{ Lot} = 18.714,54 \text{ ton} / 25.000 \text{ ton} \\ = 0,75 \approx 1 \text{ unit kapal}$$

- **Frekuensi Pemesanan**

$$\text{Frekuensi Pemesanan} = \frac{\text{Total Pemesanan}}{Q}$$

Maka,

$$\begin{aligned} \text{Frekuensi Pemesanan} &= 306.237,87 \text{ ton} / \\ &18.714,54 \text{ ton} \\ &= 16,4 \approx 16 \text{ kali} \end{aligned}$$

- ***Re-Order Point***

$$\begin{aligned} \text{ROP} &= \text{Min. Stock} \\ &= 33.189,18 \text{ ton} \end{aligned}$$



Lampiran 2

Biaya Persediaan dengan Metode Min-Max

Berikut contoh perhitungan biaya persediaan untuk bahan baku NPK Phonska:

1. Asam Sulfat

Total Biaya Persediaan (TIC)

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

Maka,

$$\begin{aligned} \text{TIC} &= ((13.022,00 \text{ ton} / 2) \times \text{Rp}36.409) + \\ & \quad ((360.609,33 / 13.022,00) \text{ ton} \times \\ & \quad \text{Rp}12.308.549) \\ &= \text{Rp}237.057.030,47 + \text{Rp}340.852.124 \\ &= \text{Rp}577.909.155 \end{aligned}$$

2. Asam Fosfat

Total Biaya Persediaan (TIC)

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

Maka,

$$\begin{aligned}
 \text{TIC} &= ((30.596,20 \text{ ton} / 2) \times \text{Rp}618.320) + \\
 & \quad ((367.154,37 / 30.596,20) \text{ ton} \times \\
 & \quad \text{Rp}24.617.098) \\
 &= \text{Rp}9.459.119.688,76 + \text{Rp}295.405.174 \\
 &= \text{Rp}9.754.524.863
 \end{aligned}$$

3. KCL Merah

Total Biaya Persediaan (TIC)

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

Maka,

$$\begin{aligned}
 \text{TIC} &= ((18.714,54 \text{ ton} / 2) \times \text{Rp}1.115.539) + \\
 & \quad ((306.237,87 / 18.714,54) \text{ ton} \times \\
 & \quad \text{Rp}46.157.058) \\
 &= \text{Rp}10.438.399.205,77 + \text{Rp}755.297.321 \\
 &= \text{Rp}11.193.696.527
 \end{aligned}$$

Lampiran 3

Standart Deviasi (σ) EOQ

1. Amoniak (NH_3)

Bulan Ke-	X	x'	$(X-x')^2$
1	23.484	13.565	98.368.405
2	19.714	13.565	37.799.144
3	15.256	13.565	2.858.588
4	16.942	13.565	11.401.649
5	17.481	13.565	15.330.082
6	13.782	13.565	46.997
7	13.127	13.565	192.339
8	9.032	13.565	20.548.906
9	5.551	13.565	64.231.572
10	6.893	13.565	44.521.885
11	7.759	13.565	33.713.110
12	13.765	13.565	39.672
TOTAL	162.785	-	329.052.348

Keterangan:

- X = Total pesanan bahan baku
- x' = Rata-rata total pesanan bahan baku
- PT Petrokimia Gresik menggunakan service level 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

$$\begin{aligned}
 \text{Standart Deviasi } (\sigma) &= \sqrt{\frac{\sum(X - x')^2}{n}} \\
 \text{Amoniak} &= \sqrt{\frac{329.052.348}{12}} \\
 &= 5.236,51
 \end{aligned}$$

2. Asam Sulfat

Bulan Ke-	X	x'	(X-x') ²
1	51.940	30.051	479.118.146
2	39.381	30.051	87.061.917
3	28.724	30.051	1.760.397
4	39.187	30.051	83.467.274
5	37.086	30.051	49.493.555
6	35.186	30.051	26.372.534
7	30.803	30.051	565.734
8	23.232	30.051	46.497.989
9	13.198	30.051	284.007.175
10	17.024	30.051	169.683.929
11	17.653	30.051	153.705.083
12	27.195	30.051	8.156.316
TOTAL	360.609	-	1.389.890.049

Keterangan:

- X = Total pesanan bahan baku
- x' = Rata-rata total pesanan bahan bak
- PT Petrokimia Gresik menggunakan service level 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

$$\begin{aligned} \text{Standart Deviasi } (\sigma) &= \sqrt{\frac{\sum(X - x')^2}{n}} \\ \text{Asam Sulfat} &= \sqrt{\frac{1.389.890.049}{12}} \\ &= 10.762,16 \end{aligned}$$

3. Asam Fosfat

Bulan Ke-	X	x'	(X-x') ²
1	46.288	30.596	246.231.792
2	38.638	30.596	64.675.930
3	27.184	30.596	11.644.653
4	37.781	30.596	51.621.749
5	35.759	30.596	26.652.291
6	32.294	30.596	2.881.335
7	29.613	30.596	967.658
8	25.722	30.596	23.753.413
9	18.491	30.596	146.540.330

10	19.864	30.596	115.180.854
11	24.617	30.596	35.745.515
12	30.904	30.596	94.539
TOTAL	367.154	-	725.990.060

Keterangan:

- X = Total pesanan bahan baku
- x' = Rata-rata total pesanan bahan bak
- PT Petrokimia Gresik menggunakan service level 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

$$\begin{aligned}
 \text{Standart Deviasi } (\sigma) &= \sqrt{\frac{\sum(X - x')^2}{n}} \\
 \text{Asam Fosfat} &= \sqrt{\frac{725.990.060}{12}} \\
 &= 7.778,12
 \end{aligned}$$

4. KCL Merah

Bulan Ke-	X	x'	(X-x') ²
1	45.258	25.520	389.594.516
2	34.633	25.520	83.051.850
3	26.781	25.520	1.589.883
4	31.412	25.520	34.717.063

5	28.783	25.520	10.646.051
6	30.477	25.520	24.576.962
7	25.633	25.520	12.878
8	15.879	25.520	92.942.465
9	14.005	25.520	132.593.826
10	17.950	25.520	57.305.358
11	17.535	25.520	63.756.396
12	17.892	25.520	58.184.572
TOTAL	306.238	-	948.971.822

Keterangan:

- X = Total pesanan bahan baku
- x' = Rata-rata total pesanan bahan bak
- PT Petrokimia Gresik menggunakan service level 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

$$\begin{aligned}
 \text{Standart Deviasi } (\sigma) &= \sqrt{\frac{\sum(X - x')^2}{n}} \\
 \text{Asam Fosfat} &= \sqrt{\frac{948.971.822}{12}} \\
 &= 8.892,75
 \end{aligned}$$

Lampiran 4

Pengendalian Persediaan dengan Metode EOQ

Berikut adalah informasi pemesanan bahan baku pupuk NPK Phonska selama 2023:

Jenis Bahan Baku	Total Pemesanan (ton)	Rata-Rata Pemesanan (ton)	Max Pemesanan (ton)	Min Pemesanan (ton)
Amoniak	162.785,40	13.565,45	23.483,53	5.550,99
Asam Sulfat	360.609,33	30.050,78	51.939,55	13.198,27
Asam Fosfat	367.154,37	30.596,20	46.287,97	18.490,81
KCl Merah	306.237,87	25.519,82	45.257,97	14.004,88

1. Asam Sulfat

- EOQ (*Economic Order Quantity*)

$$EOQ = \sqrt{\frac{2 \times S \times D}{H}}$$

$$EOQ = \sqrt{\frac{2 \times \text{biaya pesan} \times \text{jumlah pemesanan}}{\text{biaya simpan}}}$$

Maka,

$$EOQ = \sqrt{\frac{2 \times Rp12.308.549 \times 360.609,33}{Rp36.409}}$$

$$= 15.614,73 \text{ ton}$$

- Q Lot

$$Q \text{ Lot} = \frac{Q}{\text{kapasitas muat kapal}}$$

Maka,

$$Q \text{ Lot} = 15.614,73 \text{ ton} / 20.000 \text{ ton}$$

$$= 2 \text{ unit kapal}$$

- Frekuensi Pemesanan

$$\text{Frekuensi Pemesanan} = \frac{\text{Total Pemesanan}}{EOQ}$$

Maka,

$$\text{Frekuensi Pemesanan} = 360.609,33 \text{ ton} / 2 \times 15.614,73 \text{ ton}$$

$$= 12 \text{ kali}$$

- Standart Deviasi (σ)

Perhitungan untuk standart deviasi bahan baku terlampir dalam *Lampiran 3*. Dan diperoleh hasil perhitungannya sebagai berikut:

Jenis Bahan Baku	Standar Deviasi (σ)
Amoniak	5.236,51
Asam Sulfat	10.762,16
Asam Fosfat	7.778,12
KCl Merah	8.892,75

- *Safety Stock*

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

Keterangan:

- PT Petrokimia Gresik menggunakan *service level* 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

Z = *Service level* yang diinginkan

σ = Standart deviasi permintaan

LT = Lead Time atau waktu tunggu (bulan)

Maka,

$$\begin{aligned} \text{Safety Stock} &= 1,65 \times 10.762,16 \times \sqrt{0,43} \\ &= 11.689,46 \text{ ton} \end{aligned}$$

- ROP

$$ROP = (LT \times D) + SS$$

Maka,

$$\begin{aligned} \text{ROP} &= (0,43 \text{ bulan} \times 30.050,78\text{ton}) + 11.689,46 \\ &\text{ton} \\ &= 24.711,47 \text{ ton} \end{aligned}$$

2. Asam Fosfat

- EOQ (*Economic Order Quantity*)

$$EOQ = \sqrt{\frac{2 \times S \times D}{H}}$$

$$EOQ = \sqrt{\frac{2 \times \text{biaya pesan} \times \text{jumlah pemesanan}}{\text{biaya simpan}}}$$

Maka,

$$\begin{aligned} \text{EOQ} &= \sqrt{\frac{2 \times \text{Rp}24.617.098 \times 367.154,37}{\text{Rp}618.320}} \\ &= 5.406,93 \text{ ton} \end{aligned}$$

- Q Lot

$$Q \text{ Lot} = \frac{Q}{\text{kapasitas muat kapal}}$$

Maka,

$$\begin{aligned} Q \text{ Lot} &= 5.406,93 \text{ ton} / 10.000 \text{ ton} \\ &= 6 \text{ unit kapal} \end{aligned}$$

- Frekuensi Pemesanan

$$\text{Frekuensi Pemesanan} = \frac{\text{Total Pemesanan}}{EOQ}$$

Maka,

$$\text{Frekuensi} = 367.154,37 \text{ ton} / 6 \times 5.406,93 \text{ ton}$$

Pemesanan

$$= 11 \text{ kali}$$

- Standart Deviasi (σ)

Perhitungan untuk standart deviasi bahan baku terlampir dalam *Lampiran 3*. Dan diperoleh hasil perhitungannya sebagai berikut:

Jenis Bahan Baku	Standar Deviasi (σ)
Amoniak	5.236,51
Asam Sulfat	10.762,16
Asam Fosfat	7.778,12
KCl Merah	8.892,75

- *Safety Stock*

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

Keterangan:

- PT Petrokimia Gresik menggunakan *service level* 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

Z = *Service level* yang diinginkan

σ = Standart deviasi permintaan

LT = Lead Time atau waktu tunggu (bulan)

Maka,

$$\begin{aligned} \text{Safety Stock} &= 1,65 \times 7.778,12 \times \sqrt{1,00} \\ &= 12.833,90 \text{ ton} \end{aligned}$$

- ROP

$$ROP = (LT \times D) + SS$$

Maka,

$$\begin{aligned} ROP &= (1,00 \text{ bulan} \times 30.596,20 \text{ ton}) + \\ &11.081,64 \text{ ton} \\ &= 43.430,10 \text{ ton} \end{aligned}$$

3. KCL Merah

- EOQ (*Economic Order Quantity*)

$$EOQ = \sqrt{\frac{2 \times S \times D}{H}}$$

$$EOQ = \sqrt{\frac{2 \times \text{biaya pesan} \times \text{jumlah pemesanan}}{\text{biaya simpan}}}$$

Maka,

$$EOQ = \sqrt{\frac{2 \times Rp46.157.058 \times 306.237,87}{Rp1.115.539}}$$

$$= 5.034,09 \text{ ton}$$

- Q Lot

$$Q \text{ Lot} = \frac{Q}{\text{kapasitas muat kapal}}$$

Maka,

$$Q \text{ Lot} = 5.034,09 \text{ ton} / 25.000 \text{ ton}$$

$$= 4 \text{ unit kapal}$$

- Frekuensi Pemesanan

$$\text{Frekuensi Pemesanan} = \frac{\text{Total Pemesanan}}{EOQ}$$

Maka,

$$\text{Frekuensi Pemesanan} = 306.237,87 \text{ ton} / 4 \times 5.034,09 \text{ ton}$$

$$= 15 \text{ kali}$$

- Standart Deviasi (σ)

Perhitungan untuk standart deviasi bahan baku terlampir dalam *Lampiran 3*. Dan diperoleh hasil perhitungannya sebagai berikut:

Jenis Bahan Baku	Standar Deviasi (σ)
Amoniak	5.236,51
Asam Sulfat	10.762,16
Asam Fosfat	7.778,12
KCl Merah	8.892,75

- *Safety Stock*

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

Keterangan:

- PT Petrokimia Gresik menggunakan *service level* 95% dengan nilai Z sebesar 1.65 untuk menentukan nilai stok pengaman

Z = *Service level* yang diinginkan

σ = Standart deviasi permintaan

LT = Lead Time atau waktu tunggu (bulan)

Maka,

$$\begin{aligned} \text{Safety Stock} &= 1,65 \times 8.892,75 \times \sqrt{0,73} \\ &= 12.565,24 \text{ ton} \end{aligned}$$

- ROP

$$ROP = (LT \times D) + SS$$

Maka,

$$\begin{aligned} \text{ROP} &= (0,73 \text{ bulan} \times 25.519,82 \text{ ton}) + \\ & 12.565,24 \text{ ton} \\ &= 31.279,77 \text{ ton} \end{aligned}$$



Lampiran 5

Biaya Persediaan dengan Metode EOQ

Berikut contoh perhitungan biaya persediaan untuk bahan baku NPK Phonska:

1. Asam Sulfat

Total Biaya Persediaan (TIC)

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

Maka,

$$\begin{aligned} \text{TIC} &= ((15.614,73 \text{ ton} / 2) \times \text{Rp}36.409) + \\ & \quad ((360.609,33 / 15.614,73) \text{ ton} \times \\ & \quad \text{Rp}12.308.549) \\ &= \text{Rp}284.255.857,30 + \text{Rp}142.127.929 \\ &= \text{Rp}426.383.786 \end{aligned}$$

2. Asam Fosfat

Total Biaya Persediaan (TIC)

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

Maka,

$$\begin{aligned}
\text{TIC} &= ((5.406,93 \text{ ton} / 2) \times \text{Rp}618.320) + \\
&\quad ((367.154,37 / 5.406,93) \text{ ton} \times \\
&\quad \text{Rp}24.617.098) \\
&= \text{Rp}1.671.607.879,01 + \text{Rp}278.601.313 \\
&= \text{Rp}1.950.209.192
\end{aligned}$$

3. KCL Merah

Total Biaya Persediaan (TIC)

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

Maka,

$$\begin{aligned}
\text{TIC} &= ((5.034,09 \text{ ton} / 2) \times \text{Rp}1.115.539) + \\
&\quad ((306.237,87 / 5.034,09) \text{ ton} \times \\
&\quad \text{Rp}46.157.058) \\
&= \text{Rp}2.807.863.058,31 + \text{Rp}701.965.765 \\
&= \text{Rp}3.509.828.823
\end{aligned}$$