Raw Material Inventory Planning on Making Pasted Woven Cements Bags Using Materials Requirement Planning (MRP) Method at PT. ABC

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Abstract

PT ABC is a manufacturing industry that produces cement bags. At this time in PT ABC especially the production of cement bags Pasted Woven often experienced a shortage of raw materials in its production resulting in hampered production process. Of these problems caused a huge inventory cost. Based on calculations using Material Requirement Planning (MRP) method at the stage of forecasting the request of the selected method for pasted woven cement bags 1P 40 Kg SG and 1P 50 Kg SG is a Double Moving Average method with a value of N =4. While in the aggregate planning of the selected strategy is Mixed Strategy with a total cost of Rp. 5,019,479,000. In material requirement planning (MRP) method with lot sizing technique it is known that PP Yarm plastic ore item, Master Batch, PE Lamination, and Red Ink SG using lot sizing Fixed Period Requirement method with total cost in a row is Rp. 68.608.170.500, Rp. 3.232.731.480, Rp. 15.468.892.335, and Rp. 725.982.450. While Filler, PP Lamination, and Black Ink SG using the method of lot sizing Lot for Lot or Least Unit Cost with a total cost of Rp. 1.802.916.325, Rp. 74.856.745.350, and Rp. 635.701.350. From the results of the research obtained that the total cost of the company's inventory is Rp. 178,159,275,417 while using the Material Requirement Planning method of Rp. 165,331,139,790, so that savings of Rp. 12,828,135,627 with efficiency of 7.20%.

Keywords : Inventory, Material Requirement Planning, Lot for Lot, Least Unit Cost, Fixed Period Requirement.

1. Intoduction

Inventory is a valuable asset in a manufacturing industry company, which has an important role for the sustainability of the production process, especially the supply of raw materials. Inventory planning is one of the techniques in setting the needs of raw materials based on the amount of volume, the number of order periods with regard to the available facilities (Arif, Supriyadi, &Cahyadi, 2017). Planning the supply of raw materials has the benefit of minimizing the risk of delay in raw materials, and is able to provide raw material needs for production so that raw materials do not accumulate excessively (Assauri, 1999).

PT ABC is one of the manufacturing industry companies that produce cement bags by producing 3 (three) types of cement bags namely, Pasted Kraft, Sewn Woven and Pasted Woven. Currently at PT ABC especially the production of pasted woven cement bags often experience a shortage of raw materials in its production.

To solve the above problems, there needs to be proper and efficient planning of raw material supplies. Methods used in the management of raw material inventory there are various ones using the method of Material Requirement Planning (MRP). According to Heizer and Render (2015) "Material Requirement Planning (MRP) is "a dependent demand technique that uses material lists, supplies, expected receipts, and production master schedules to determine material needs.

2. Research Method

2.1 Forecasting

According to Buffa S. Elwood, (1996) "Forecasting is defined as the use of statistical techniques in the form of future images based on the processing of historical figures".

According to Makridakis, (1992) "Forecasting is an integral part of management decision-making activities".

2.2 Forecasting Techniques

In the method of periodic series (time series) in general the forecasting technique is divided into i.e.: (Makridakis,1992)

Double Moving Average

If the data is not stationary and contains trend patterns, then moving averages are carried out against the results of single moving averages.

Formulas used:

$$S'_t = \frac{X_t + X_{t-1} + X_{t-2} + \cdots + X_{t-N+1}}{N} \quad (1)$$

$$S''_t = \frac{S'_t + S'_{t-1} + S'_{t-2} + \cdots + S'_{t-N+1}}{N} \quad (2)$$

$$a_t = S'_t + (S'_t - S''_t) = 2S'_t - S''_t \quad (3)$$

$$b_t = \frac{2}{N-1}(S'_t - S''_t) \quad (4)$$

$$F_{t+m} = a_t + b_t m \quad (5)$$

Where:

S'_t	= Single moving average value
X_t	= Demand in the period t
N	= The amount of past value
S''_t	= Double moving average value
a_t	= *Interceptions in periods t*
b_t	= *Period trend value t*
m	= Number of foreseeable future time periods

Double Exponential Smoothing

The rationale of Brown's linear exponential smoothing is similar to the linear moving average, as both single and double-stroke refinements are missing from the actual data when there is a trend element. The equations used from this method are as follows:

$$S'_t = \alpha X_t + (1 - \alpha) S'_{t-1} \quad (6)$$

$$S''_t = \alpha S'_t + (1 - \alpha) S''_{t-1} \quad (7)$$

Where S'_t is a single exponential smoothing value and S''_t is a double exponential smoothing value.

$$a_t = S'_t + (S'_t - S''_t) = 2S'_t - S''_t \quad (8)$$

$$b_t = \frac{\alpha}{1-\alpha}(S'_t - S''_t) \quad (9)$$

$$F_{t+m} = a_t + b_t m \quad (10)$$

Where:

S'_{t-1} = Single exponential smoothing value of the previous period
S''_{t-1} = Previous period double exponential smoothing value
a_t = *Interceptions in periods t*
b_t = *Period trend value t*
m = Number of foreseeable future time periods

Triple Exponential Smoothing

As with linear exponential smoothing that can be used to forecast data with a basic trend pattern, a higher form of refinement can be used when the basis of the data pattern is quadratic, cubic, or higher order.

The equation for quadratic smoothing is:

$$S'_t = \alpha X_t + (1 - \alpha)\, S'_{t-1} \quad (11)$$

$$S''_t = \alpha S'_t + (1 - \alpha)\, S''_{t-1} \quad (12)$$

$$S'''_t = \alpha S''_t + (1 - \alpha)\, S'''_{t-1}) \quad (13)$$

$$a_t = 3S'_t - 3S''_t + S'''_t \quad (14)$$

$$b_t = \frac{\alpha}{2(1-\alpha)^2}\left[(6 - 5\alpha)\, S'_t - (10 - 8\alpha)\, S''_t + (4 - 3\alpha)\, S'''_t\right] \quad (15)$$

$$c_t = \frac{\alpha^2}{(1-\alpha)^2}\left(S'_t - 2S''_t + S'''_t\right) \quad (16)$$

$$F_{t+m} = a_t + b_t m + \frac{1}{2} c_t m \quad (17)$$

2.3 Aggregate Planning

According to Sofyan, Diana Khairani (2013) Aggregate planning (agregate planning) is also known as aggregate scheduling which is an approach taken by companies to determine the quantity and production time in the medium period (usually between 3 (three) to 12 months ahead) aggregate planning can be used in determining the best way to meet the predicted demand by adjusting the production value, labor level, inventory level, overtime labor level , subcontracting levels and other variables that can be controlled.

Level Strategy

Strategy level is defined as an aggregate planning method where production levels remain but demand changes. Characteristics of this strategy (1) Maintain a steady production rate. (2) Fluctuating inventory levels, order backlogs and lost seads.

Chase Strategy

Chase strategy is defined as an aggregate planning method where the production rate is adjusted to demand. Characteristics of this strategy: (1) Adjust production levels to demand levels. (2) Adding and subtracting workers on demand.

Mixed Strategy

Mixed strategy is defined as an aggregate planning method that combines Level Strategy and Chase strategy methods. Characteristics of this strategy: (1) Has a fixed production rate at some periods and fluctuates changes in the demand berasi that period is set. (2) Adding and subtracting workers according to demand.

2.4 Aggregation

Before performing the production master schedule (JIP) is carried out the process of aggregation. The process of aggregation is the process of changing the aggregate plan result to the amount that must be produced for each item/product. In this study the authors used percentage techniques to perform the aggregation process.

2.5 *Material Requirement Planning (MRP)*

The MRP has several definitions, the operations managers have found a wide knowledge that the MRP system can be an effective and competitive way to be successful in the global economy. In general, MRP is a logical procedure, decision rules and computerized recording techniques designed to translate the Master Production Schedule/MPS into net requirement for all items. In other words, MRP is a concept that discusses the right way of planning the needs of goods in the production process, so that the goods needed can be available as planned.

MRP techniques cover all the needs of material needs, where there are two main functions, namely as inventory control and as production scheduling. While the purpose of the MRP itself is to determine the needs at once to support the parent production schedule, control inventory, schedule production, maintain a valid and timely schedule, and in particular can be useful in the company's manufacturing environment.

Lot sizing techniques in the MRP include: (a) Fixed Order Quantity, (b)Lot for Lot, (c) Economic Order Quantity, (d) Period Order Quantity, (e) Least Unit Cost, (f) Least Total Cost, (g) Part Period Balancing, (h) Fixed Period Requirement

3. Result and Discussion

Table 1 Raw material inventory, price/kg and cost of ordering, storing cost data at the end of March 2020 as weel as lead time raw Materials

No	Raw material	Final Stock (kg)	Price (Rp/kg)	Cost Order (booking fee) (Rp)	Storege Cost (Rp/kg)	Lead Time (day)
1	PP Yarm plastic seeds	189.780	20.000	2.000.000	100	7
2	PP Laminasi plastic seeds	205.650	22.000	2.000.000	110	7
3	PE Laminasi plastic seeds	87.900	17.000	2.000.000	85	7
4	Master Batch	15.175	72.000	3.500.000	360	7
5	Filler	17.230	15.000	3.500.000	75	7
6	Black Ink SG	240	93.000	1.500.000	4650	3
7	Black Red SG	225	99.000	1.500.000	4950	3

Table 2. Compony Inventory Cost

TIC	PP Yarm plastic seeds (Rp)	PP Laminasi plastic seeds (Rp)	PE Laminasi plastic seeds (Rp)	Master Batch (Rp)	Filler	Black Ink	Black Red
Biaya Tetap	74.126.860.000	4.283.800.000	1.790.790.000	79.242.715.200	15.656.677.000	657.459.000	616.218.000
Biaya Variabel	108.706.343	630.059.498	131.369.386	113.601.941	85.920.981	371.256.641	348.756.626
Total Biaya	74.235.566.343	4.913.859.498	1.922.159.386	79.356.317.141	15.742.597.981	1.028.715.641	964.974.626

Bill of material is a series of all components used to produce finished goods. The composition for making pasted woven cement bags is PP Yarm plastic ore, PP laminated plastic ore, PE laminated plastic ore, batch master, filler, red ink and SG black ink. Here is the Bill of material for producing cement bags pasted woven 1P 40 Kg SG and 1P 50 Kg SG can be seen in Table 3 and Table 4.

Table 3 Bill Of Cement Bag Material Pasted Woven 1P 40 Kg SG/Bag

Level	Name of Raw Materials	Sum	Source
0	PP Woven 1P 40 Kg SG	61,5 cm x 49,5 cm	Do
1	Thread	0,15 kg	Do
1	Laminate	0,181 kg	Do
1	SG Red Ink	0,0003 kg	Do
1	SG Black Ink	0,0003 kg	Do
2	Plastic Ore PP Yarm	0,143 kg	Do
2	Master Batch	0,002 kg	Do
2	Filler	0,01 kg	Do
2	Laminated PP Plastic Ore	0,143 kg	Do
2	Laminated PE Plastic Ore	0,033 kg	Do

Table 4 Bill Of Cement Bag Material Pasted Woven 1P 50 Kg SG/Bag

Level	Name of Raw Materials	Sum	Source
0	PP Woven 1P 40 Kg SG	63 cm x 50 cm	Do
1	Thread	0,176 kg	Do
1	Laminate	0,223 kg	Do
1	SG Red Ink	0,0003 kg	Do
1	SG Black Ink	0,0003 kg	Do
2	Plastic Ore PP Yarm	0,167 kg	Do
2	Master Batch	0,003 kg	Do
2	Filler	0,012 kg	Do
2	Laminated PP Plastic Ore	0,167 kg	Do
2	Laminated PE Plastic Ore	0,05 kg	Do

3.1 Demand Forecasting

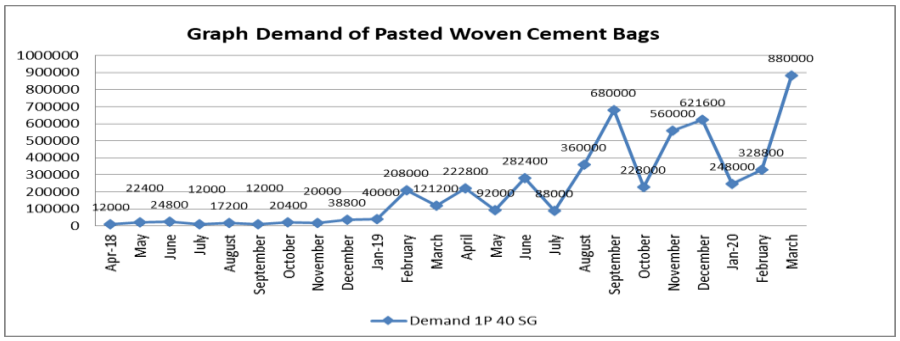

Fig. 1 Cement Pasted Woven Bag Request Chart 1P40 Kg SG April 2018 – March 2020

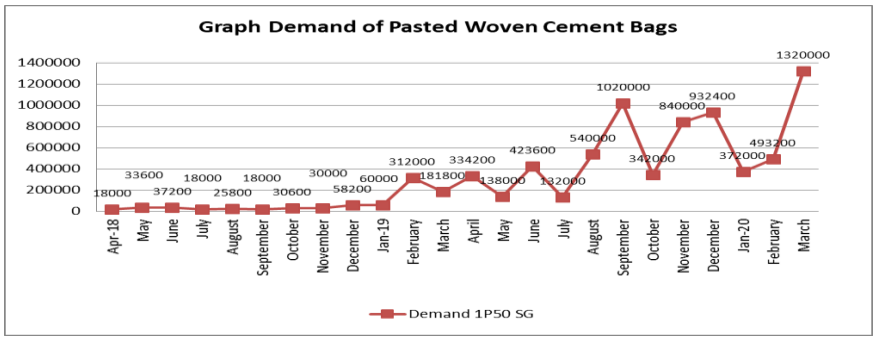

Fig 2. Cement Pasted Woven Bag Demand Chart 1P50 Kg SG April 2018 – March 2020

From Fig 1 and Fig 2 it can be known that the demand data two years ago tends to be trend or exponential. Appropriate forecasting methods are Double Moving Average, Double Exponential Smoothing, and Triple Exponential Smoothing.

3.2 Forecasting Accuracy

From Table 3 that the method that has the smallest error value for forecasting cement bags pasted woven 1P40 Kg SG is the Triple Exponential Smoothing method with a value of α 0.05 because it has a MAPE value of 44.05%.

Table 3 Calculation Results Accuracy Of Pasted Woven Bag Forecasting 1P40 Kg SG

Error Value	Double Moving Average			
	N = 3	N = 4	N = 5	
MAD	143660,82	157504,41	189412,80	
MSE	44675293879,14	49690129203,43	58933266615,47	
MAPE	64,78	65,82	72,55	
Error Value	Double Exponential Smoothing			
	α = 0,05	α = 0,1	α = 0,5	α = 0,9
MAD	139220,56	124340,58	146147,26	111397,10
MSE	52054624087,33	35564424048,98	50570170309,37	96849080172,63
MAPE	46,32	46,14	69,18	49,17
Nilai Error	Triple Exponential Smoothing			
	α = 0,05	α = 0,1	α = 0,5	α = 0,9
MAD	125428,42	122163,00	186297,90	341377,19
MSE	39811549709,73	30340858300,30	77328899653,29	232888023900,94
MAPE	44,05	50,81	90,44	174,58

From Table 4 that the method that has the smallest error value for pasted woven cement bag forecasting 1P50 Kg SG is Triple Exponential Smoothing method with a value of α 0.05 because it has a MAPE value of 44.32%.

Table 4 Calculation Results Accuracy Of Pasted Woven Bag Forecasting 1P50 Kg SG

Error Value	Double Moving Average			
	N = 3	N = 4	N = 5	
MAD	215491,23	217509,56	240698,93	
MSE	100519411228,07	111802790707,72	132599849884,80	
MAPE	64,78	65,94	71,81	
Nilai Error	Double Exponential Smoothing			
	α = 0,05	α = 0,1	α = 0,5	α = 0,9
MAD	209889,97	186675,57	219193,57	331418,95
MSE	117328119594,92	79850741037,66	113783545793,12	217917397018,85
MAPE	47,87	46,24	69,36	112,16
Error Value	Triple Exponential Smoothing			
	α = 0,05	α = 0,1	α = 0,5	α = 0,9
MAD	188452,91	183008,72	279669,65	512446,17
MSE	89357630395,22	68101578465,85	174000461118,35	524024005186,96
MAPE	44,32	50,52	91,37	175,27

3.3 Forecasting Verification

Moving Range

Table 5 Calculation Result Moving Range Cement Bag Pasted Woven 1P40 Kg SG

Month	Period	1P 40 SG	Forecasting	$e_t = X_t - F_t$	$e_t - e_{t-1}$	Moving Range $\lvert e_t - e_{t-1} \rvert$
Apr-18	1	12000	-	-	-	-
May	2	22400	-	-	-	-
June	3	24800	-	-	-	-
July	4	12000	-	-	-	-
August	5	17200	-	-	-	-
September	6	12000	-	-	-	-
October	7	20400	-	-	-	-
November	8	20000	12400	7600	-	-
December	9	38800	17900	20900	13300	13300
January 2019	10	40000	30758	9242	-11658	11658
February	11	208000	43883	164117	154875	154875
March	12	121200	143408	-22208	-186325	186325
April	13	222800	175625	47175	69383	69383
May	14	92000	246125	-154125	-201300	201300
June	15	282400	226125	56275	210400	210400
July	16	88000	232850	-144850	-201125	201125
August	17	360000	181842	178158	323008	323008
September	18	680000	249308	430692	252533	252533
October	19	228000	561475	-333475	-764167	764167
November	20	560000	458792	101208	434683	434683
December	21	621600	654417	-32817	-134025	134025
January 2020	22	248000	696817	-448817	-416000	416000
Februar	23	328800	383067	-54267	394550	394550
March	24	880000	408350	471650	525917	525917
Jumlah	300	5140400	4723142	296458	464050	4293250
					$\overline{MR}$	286216,67
					BKA	761336,33
					BKB	-761336,33

The upper and lower control limits of the Moving Range are:

BKA = 2,66 X $\overline{MR}$

BKA = 2,66 X 286216.67 = 761336.33

BKB = -2,66 X $\overline{MR}$

BKB = -2,66 X 286216.67 = -761336.33

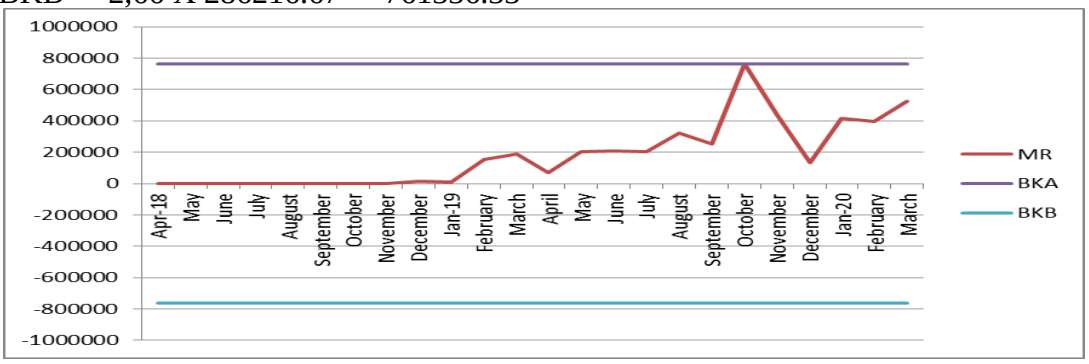

Fig. 5 Moving Range Cement Bag Pasted Woven 1P40 Kg SG Chart

Tracking Signal

Tabel 6. Calculation Result Tracking Signal Bag Cement Pasted Woven 1P40 Kg SG

Month	Period	1P 40 SG	Forecasting	$e_t = X_t - F_t$	Cumulative RSFE	$\lvert e_t = X_t - F_t \rvert$	Cumulative Absolute Error	MAD	Tracking Signal
Apr-18	1	12000	-	-	-	-	-	-	-
May	2	22400	-	-	-	-	-	-	-
June	3	24800	-	-	-	-	-	-	-
July	4	12000	-	-	-	-	-	-	-
August	5	17200	-	-	-	-	-	-	-
September	6	12000	-	-	-	-	-	-	-
October	7	20400	-	-	-	-	-	-	-
November	8	20000	12400	7600	7600	7600	7600	950	8
December	9	38800	17900	20900	28500	20900	28500	3167	9
January 2019	10	40000	30758	9242	37742	9242	37742	3774	10
February	11	208000	43883	164117	201858	164117	201858	18351	11
March	12	121200	143408	-22208	179650	22208	224067	18672	9,621
April	13	222800	175625	47175	226825	47175	271242	20865	10,871
May	14	92000	246125	-154125	72700	154125	425367	30383	2,393
June	15	282400	226125	56275	128975	56275	481642	32109	4,017
July	16	88000	232850	-144850	-15875	144850	626492	39156	-0,405
August	17	360000	181842	178158	162283	178158	804650	47332	3,429
September	18	680000	249308	430692	592975	430692	1235342	68630	8,640
October	19	228000	561475	-333475	259500	333475	1568817	82569	3,143
November	20	560000	458792	101208	360708	101208	1670025	83501	4,320
December	21	621600	654417	-32817	327892	32817	1702842	81088	4,044
January 2020	22	248000	696817	-448817	-120925	448817	2151658	97803	-1,236
Februar	23	328800	383067	-54267	-175192	54267	2205925	95910	-1,827
March	24	880000	408350	471650	296458	471650	2677575	111566	2,657
Sum	300	5140400	4723142	296458	2571675	2677575	16321342	835826	88
								BKA	14,574
								BKB	-14,574

The average Tracking Signal is:

$$\overline{TS} = \frac{\sum TS}{n-1}$$

$$\overline{TS} = \frac{88}{17-1} = 5{,}479$$

The upper and lower control limits of the Tracking Signal are:

BKA = 2,66 X $\overline{TS}$

BKA = 2,66 X 5,479 = 14,574

BKB = -2,66 X $\overline{TS}$

BKB = -2,66 X 5,479 = -14,574

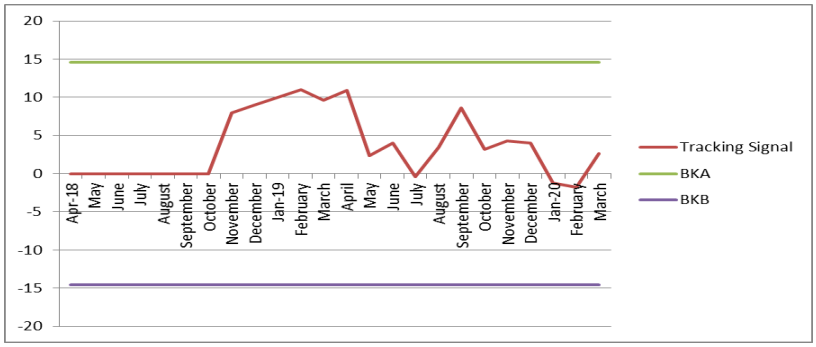

Fig. 6 Chart Tracking Signal Bag Cement Pasted Woven 1P40 Kg S G

3.4 Selected Forecasting Results

From the results of accuracy and verification of forecasting methods selected for pasted woven cement bags 1P 40Kg and 1P 50 Kg SG is the Double Moving Average method with a value of N=4.

Table 7. Results of Pasted Woven Cement Bag Demand Forecast period April 2020 – March 2021

Month	Pasted Woven cement Bag		Total Demand
	IP40 Kg SG	IP50 Kg SG	
Apr-20	595600	893400	1489000
May	626000	989000	1565000
June	656400	984600	1641000
July	686800	1030200	1717000
August	717200	1075800	1793000
September	747600	1121400	1869000
October	778000	1167000	1925000
November	808400	1212600	2021000
December	838800	1258200	2097000
Jan-21	869200	1303800	2173000
February	899600	1349400	2249000
March	830000	1395000	2325000
Total	9053600	13780400	22864000

3.5 Aggregate Planning

Tabel 8 Aggregate Planing Level Strategy

Month	Demand	Week days	Production	Regular (unit)	Overtime (unit)	Undertime (unit)	Final Inventory	Work Force	Overtime (hour)	Overtime costs (Rp.)	Regular Fees (Rp.)
March 20							105000	300			
April	1489000	26	1907000	3900000	-	1993000	523000	300	-	-	759900000
May	1565000	26	1907000	3900000	-	1993000	865000	300	-	-	759900000
June	1641000	26	1907000	3900000	-	1993000	1131000	300	-	-	759900000
July	1717000	27	1907000	4050000	-	2143000	1321000	300	-	-	759900000
August	1793000	26	1907000	3900000	-	1993000	1435000	300	-	-	759900000
September	1869000	26	1907000	3900000	-	1993000	1473000	300	-	-	759900000
October	1945000	27	1907000	4050000	-	2143000	1435000	300	-	-	759900000
November	2021000	25	1907000	3750000	-	1843000	1321000	300	-	-	759900000
December	2097000	27	1907000	4050000	-	2143000	1131000	300	-	-	759900000
January20	2173000	26	1907000	3900000	-	1993000	865000	300	-	-	759900000
February	2249000	24	1907000	3600000	-	1693000	523000	300	-	-	759900000
March	2325000	27	1907000	4050000	-	2143000	105000	300	-	-	759900000
Total	22884000	313	22884000	46950000	0	24066000	12128000	3600	0	0	9118800000
	1907000										9118800000

Tabel 9. Aggregate Planing Chase Strategy

Month	Demand	Weekdays	Production	Regular (unit)	Overtime (unit)	Undertime (unit)	Final Inventory	Work Force	Firing	Hiring	Regular Fees (Rp.)	Firing Costs (Rp.)	Hiring Costs (Rp.)
March 20							105000	300					
April	1489000	26	1489000	1495000	-	6000	105000	115	185	-	291295000	555000000	-
May	1565000	26	1565000	1573000	-	8000	105000	121	-	6	306493000		2100000
June	1641000	26	1641000	1651000	-	10000	105000	127	-	6	321691000		2100000
July	1717000	27	1717000	1728000	-	11000	105000	128	-	1	324224000		350000
August	1793000	26	1793000	1794000	-	1000	105000	138	-	10	349554000		3500000
September	1869000	26	1869000	1872000	-	3000	105000	144	-	6	364752000		2100000
October	1945000	27	1945000	1957500	-	12500	105000	145	-	1	367285000		350000
November	2021000	25	2021000	2025000	-	4000	105000	162	-	17	410346000		5950000
December	2097000	27	2097000	2106000	-	9000	105000	156	6	-	395148000	18000000	-

Month	Demand	Weekdays	Production	Regular (unit)	Overtime (unit)	Undertime (unit)	Final Inventory	Work Force	Firing	Hiring	Regular Fees (Rp.)	Firing Costs (Rp.)	Hiring Costs (Rp.)
January20	2173000	26	2173000	2184000	-	11000	105000	168	-	12	425544000		4200000
February	2249000	24	2249000	2256000	-	7000	105000	188	-	20	476204000		7000000
March	2325000	27	2325000	2335500	-	10500	105000	173	15		438209000	45000000	-
Total	22884000	313	22884000	22977000	0	93000	1260000	1765	206	79	4470745000	618000000	27650000
												5116395000	

Tabel 10. Aggregate Mixed Strategy

Month	Demand	Weekdays	Production	Regular (unit)	Undertime (unit)	Final Inventory	Work force	Firing	Hiring	Overtime (hour)	Regular Fees (Rp.)	Firing Costs (Rp.)	Hiring Costs (Rp.)
March 20						105000	300						
April	1489000	26	1565000	1573000	8000	181000	121	179	-	-	306493000	537000 000	-
May	1565000	26	1565000	1573000	8000	181000	121	-	-	-	306493000	-	-
June	1641000	26	1565000	1573000	8000	105000	121	-	-	-	306493000	-	-
July	1717000	27	1717000	1728000	11000	105000	128	-	7	-	324224000	-	2450000
August	1793000	26	1793000	1794000	1000	105000	138	-	10	-	349554000	-	3500000
September	1869000	26	1869000	1872000	3000	105000	144	-	6	-	364752000	-	2100000
October	1945000	27	1945000	1957500	12500	105000	145	-	1	-	367285000	-	350000
November	2021000	25	2173000	2112500	-60500	257000	169	-	24	-	428077000	-	8400000
December	2097000	27	2173000	2281500	108500	333000	169	-	-	-	428077000	-	-
January 20	2173000	26	2173000	2197000	24000	333000	169	-	-	-	428077000	-	-
February	2249000	24	2173000	2028000	-145000	257000	169	-	-	-	428077000	-	-
March	2325000	27	2173000	2281500	108500	105000	169	-	-	-	428077000	-	-
Total	22884000	313	22884000	22971000	87000	2172000	1763	179	48	0	4465679000	537000 000	16800000

3.6 Aggregation

Table 11 Percentage Demand for Pasted Woven Cement Bags

Month	Pasted Woven Cement Bags		Total Demand
	1P40 Kg SG	1P50 Kg SG	
April 2020	595600	893400	1489000
May	626000	939000	1565000
June	656400	984600	1641000
July	686800	1030200	1717000
August	717200	1075800	1793000
September	747600	1121400	1869000
October	778000	1167000	1945000
November	808400	1212600	2021000
December	838800	1258200	2097000
January 2021	869200	1303800	2173000
February	899600	1349400	2249000
March	930000	1395000	2325000
Jumlah	9153600	13730400	22884000

In Table 11 known percentage for pasted woven cement bags 1P40 Kg SG by 40% while for pasted woven cement bags 1P50 Kg SG is 60%. After each percentage is known the next step is to find each product to be produced based on the amount of production in aggregate planning with mixed strategy method. Here's an example of the calculation: The process is aggregated in April 2020 from the aggregate planning of the Mix Strategy method which is 1565000 bag.

a. 1P40 Kg SG = 40% x 1565000 bag = 626000 bag and so on.
b. 1P50 Kg SG = 60% x 1565000 bag = 939000 bag and so on.

3.7 Production Master Schedule

Table 12 Production Master Schedule

Month	Pasted woven Cement Bags	
	1P40	1P50
April 2020	626000	939000
May	626000	939000
June	626000	939000
July	686800	1030200
August	717200	1075800
September	747600	1121400
October	778000	1167000
November	869200	1303800
December	869200	1303800
January 2021	869200	1303800
February	869200	1303800
March	869200	1303800

3.8 Raw Material Needs Planning

Table 13 Total Raw Material Needs of Pasted Woven Cement Bags

Month	Raw Materials						
	Plastic ore PP Yarm (kg)	Master Batch (kg)	Filler (kg)	Laminated PP Plastic Ore (kg)	Laminated PE Plastic Ore (kg)	Red Ink SG (kg)	Black Ink SG (kg)
April 2020	246331	4069	8764	246331	67608	470	470
May	246331	4069	8764	246331	67608	470	470
June	246331	4069	8764	246331	67608	470	470
July	270256	4464	9615	270256	74174	515	515
August	282218	4662	10041	282218	77458	538	538
September	294181	4859	10466	294181	80741	561	561
October	306143	5057	10892	306143	84024	584	584
November	342030	5650	12169	342030	93874	652	652
December	342030	5650	12169	342030	93874	652	652
January 2021	342030	5650	12169	342030	93874	652	652
February	342030	5650	12169	342030	93874	652	652
March	342030	5650	12169	342030	93874	652	652

3.9 Calculation of Safety Stock and ReOrder Point

Table 14 Safety Stock and ReOrder Point per Raw Material Item

Materials	Safety Stock	ReOrder Point
PP Yarm plastic seeds	30403	111120
PP Laminasi plastic seeds	508	1845
PE Laminasi plastic seeds	1088	3965
Master Batch	30403	111120
Filler	8345	30500
Black Ink SG	42	108
Red Ink SG	42	108

3.10 Lot Size Calculation

To determine the lot size used method Lot for Lot, Least Unit Cost and Fixed Period Requirement.

Lot for Lot Method

From the calculation of lot sizing using the Method of Lot for Lot obtained the total cost of each item of raw materials as follows:

Table 15 Calculation of Total Cost of Lot for Lot Method

No.	Materials	Lot Sizing Technique
		Lot for Lot
1	PP Yarm plastic seeds	Rp. 74.126.852.000
2	PP Laminasi plastic seeds	Rp. 3.456.785.448
3	PE Laminasi plastic seeds	Rp. 1.802.916.325
4	Master Batch	Rp. 74.856.745.350
5	Filler	Rp. 15.711.096.000
6	Black Ink SG	Rp. 750.021.000
7	Red Ink SG	Rp. 635.701.350

Least Unit Cost Method

From the calculation of lot sizing using the Least Unit Cost method obtained the total cost of each raw material item as follows:

Table 16 Calculation of Total Cost of Least Unit Cost Method

No.	Materials	Lot Sizing Technique
		Least Unit Cost
1	PP Yarm plastic seeds	Rp. 74.126.852.000
2	PP Laminasi plastic seeds	Rp. 3.456.785.448
3	PE Laminasi plastic seeds	Rp. 1.802.916.325
4	Master Batch	Rp. 74.856.745.350
5	Filler	Rp. 15.711.096.000
6	Black Ink SG	Rp. 750.021.000
7	Red Ink SG	Rp. 635.701.350

Fixed Period Requirement Method

From the calculation of lot sizing using Fixed Period Requirement method obtained the total cost of each raw material item as follows:

Table 17 Calculation of Total Cost of Fixed Period Requirement Method

No.	Materials	Lot Sizing Technique
		Fixed Period Requirement
1	Plastic ore PP Yarm	Rp. 68.608.170.500
2	Laminated PP plastic ore	Rp. 3.232.731.480
3	Laminated PE plastic ore	Rp. 1.865.624.975
4	Master Batch	Rp. 75.151.838.220
5	Filler	Rp. 15.468.892.335
6	Black Ink SG	Rp. 725.982.450
7	Red Ink SG	Rp. 654.577.350

3.11 Lot Size Method Selection

Here is a comparison of the cost of each raw material item:

Table 18 Comparison of Total Cost of Each Raw Material Item

No.	Materials	Lot Sizing Technique		
		Lot for Lot	Least Unit Cost	Fixed Period Requirement
1	Plastic ore PP Yarm	Rp. 74.126.852.000	Rp. 74.126.852.000	Rp. 68.608.170.500
2	Laminated PP plastic ore	Rp. 3.456.785.448	Rp. 3.456.785.448	Rp. 3.232.731.480
3	Laminated PE plastic ore	Rp. 1.802.916.325	Rp. 1.802.916.325	Rp. 1.865.624.975
4	Master Batch	Rp. 74.856.745.350	Rp. 74.856.745.350	Rp. 75.151.838.220
5	Filler	Rp. 15.711.096.000	Rp. 15.711.096.000	Rp. 15.468.892.335
6	Black Ink SG	Rp.750.021.000	Rp.750.021.000	Rp. 725.982.450
7	Red Ink SG	Rp. 635.701.350	Rp. 635.701.350	Rp. 654.577.350

3.12 Comparison of Company Inventory Costs with Selected MRP Methods

From the calculation of the selected MRP method the results compared to the costs incurred by the company can be seen in table 9

Table 19 Comparison of Company Inventory Costs with Selected MRP Methods

No.	Materials	Lot Sizing Technique	Inventory Costs	
			MRP method	Company (Method according to number of needs)
1	Plastic ore PP Yarm	Fixed Period Requirement	Rp 68.608.170.500,00	Rp 74.230.566.343,00
2	Laminated PP plastic ore	Fixed Period Requirement	Rp 3.232.731.480,00	Rp 4.913.944.298,40
3	Laminated PE plastic ore	Lot for Lot / Least Unit Cost	Rp 1.802.916.325,00	Rp 1.922.159.386,00
4	Master Batch	Lot for Lot / Least Unit Cost	Rp 74.856.745.350,00	Rp 79.356.317.141,60
5	Filler	Fixed Period Requirement	Rp 15.468.892.335,00	Rp 15.742.597.981,00
6	Black Ink SG	Fixed Period Requirement	Rp 725.982.450,00	Rp 1.028.715.641,00
7	Red Ink SG	Lot for Lot / Least Unit Cost	Rp 635.701.350,00	Rp 964.974.626,00
Total Biaya			Rp 165.331.139.790,00	Rp 178.159.275.417,00
Information:		Method used		

By using MRP method, PT ABC can save more inventory costs of Rp. 12,828,135,627 from the previous inventory cost of Rp. 178,159,275,417. So the efficiency obtained by PT ABCis 7.20% of the previous inventory cost. With the following calculations:

$$\text{Efficiency} = \frac{12.828.135.627}{178.159.257.417} \text{ x } 100\% = 7{,}20\%$$

4. Conclusion

a. Based on the accuracy of forecasting and verification of forecasting methods suitable for pasted woven cement bags 1P 40 Kg and 1P 50 Kg SG is a double moving average method with a value N=4.
b. For aggregate planning using Mixed Strategy method because it has a smaller cost of Rp. 5,019,479,000.
c. The use of lot sizing method for each raw material can be seen in the table below:

No.	Materials	Lot Sizing Technique	MRP method	
1	Bijih Plastik PP Yarm	Fixed Period Requirement	Rp	68.608.170.500,00
1	Plastic ore PP Yarm	Fixed Period Requirement	Rp	3.232.731.480,00
2	Laminated PP plastic ore	Fixed Period Requirement	Rp	1.802.916.325,00
3	Laminated PE plastic ore	Lot for Lot / Least Unit Cost	Rp	74.856.745.350,00
4	Master Batch	Lot for Lot / Least Unit Cost	Rp	15.468.892.335,00
5	Filler	Fixed Period Requirement	Rp	725.982.450,00
6	Black Ink SG	Fixed Period Requirement	Rp	635.701.350,00

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