CHAPTER 4

INVENTORY MANAGEMENT

4.1 MEANING, DEFINITION AND IMPORTANCE
4.2 INVENTORY CONTROL
4.3 INVENTORY OPERATION
4.4 INVENTORY STRUCTURES IN CEMENT FACTORIES
4.5 CONCLUSION
4.1 Meaning and Definition of Inventory Management and Control

Inventory management is one of the most important areas in materials management. In order to continue to be profitable, an enterprise must be operated according to some plan based on some estimate of the future demand. It plays a vital role in the economic operation of the enterprises. Some authors say that "to achieve higher operational efficiency and profitability of an organisation, it is very essential to reduce the amount of capital better locked up in inventories. This will not only help in achieving better return on investment by minimising tied-up working capital but will also improve the liquidity position of the company" (1). Inventory management is "the branch of business management concerned with the development of policies to which the firm's inventory is meant to conform" (2).

Inventory means "An itemized list of current assets." (3)
The meaning of the terms "stock" and "inventory" are as follows (4):

Inventory means tangible property held
1. for sale in the ordinary course of business, or
2. in the process of production for such sale, or
3. for consumption in the production of goods or services for sale, including maintenance, supplies and consumables other than machinery spares".

According to Monks "An inventory is an idle resource that possesses economic value." (5)
R. Viswanathan has rightly observed that "inventory is nothing but a stock of goods.....that we maintain to facilitate the continuous production of goods and services"(6).

We have discussed in the previous chapters, Value Analysis, Purchasing, Standardisation, Codification, Storage and Transportation and inventory control. All of the above topics are disciplines under materials management.

Control over inventories means good long-range and intermediate planning of production operations, good production scheduling and good methods of control. A comprehensive inventory-control system including production planning, scheduling and control must be closely coordinated with other planning and control activities such as planning, capital budgeting and sales forecasting. It may be also defined as "The technique of maintaining stock-keeping items at desired levels whether they be raw materials, goods in process or finished products"(7).

According to R S Chadda, "inventories greatly in excess of amount needed to carry on the processes of production and distribution are not the sign of prosperity."(8).

4.1.1 Importance of Inventory Management and Control:

The primary objective of a business enterprise is to secure a reasonable return on its capital investment. According to B.W. Aljian "inventory which in many companies represents from 30 to 70% of the total capital invested in business is actually the lifeblood of the business"(9).

Inventories are a major asset and represent a sizeable investment in business that sell or manufacture products.

Size of inventory in cement factories in India (Table 4.1)
Table (4-1)

(Rs. in crores)

<table>
<thead>
<tr>
<th>Year ending</th>
<th>Total value of inventories</th>
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<tr>
<td>1986-87</td>
<td>133</td>
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<tr>
<td>1987-88</td>
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<td>1991-92</td>
<td>735</td>
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<td>922</td>
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<td>1182</td>
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<tr>
<td>1994-95</td>
<td>1477</td>
</tr>
<tr>
<td>1995-96</td>
<td>1869</td>
</tr>
<tr>
<td>1996-97</td>
<td></td>
</tr>
</tbody>
</table>

Source: Annual Reports of R.B.I.

4.2.0 Inventory Control

Raw materials, work-in-process goods, finished goods, spare parts and stores and the main constituents of an inventory. In cement factories inventory control is very important because of a large number of the inventory are kept in this industry.

4.2.1 Meaning of Inventory Control

Inventory control is also concerned with investment in materials and parts, but it is pre-determined in accordance with inventory policy pursued by the management. It is a scientific method of
controlling inventory items at desired levels on the basis of production costs, sales, profit and cost of carrying inventories. According to J. I. Bogen, "Effective inventory control should provide adequate stocks of goods of proper quality to meet the requirements of production and sales, while at the same time keeping the required investment to a minimum. Increases or decreases in the inventory investment must be tested against the effect on profits as well as on working capital needs" (10).

Inventory control is the science based on the art of ensuring that just enough inventories are kept for running production and to ensure that there is no more or less inventory. It is primarily concerned with obtaining the correct balance between the two.

Inventory control has been defined by Evar. L. Kohler as "the Control of merchandise, materials, goods in process, finished goods and supplies on hand by accounting and physical methods" (11). Accounting control includes the proper measurement of inventory amount, Physical control involves the physical movement of inventories and consists of proper safeguards for storing, handling, issuing and inventory taking. American production and inventory control society has defined inventory control as "the technique of maintaining stock-keeping items at desired levels, whether they be raw materials, work-in-process, or finished goods" (12).

The importance of inventory management in cement factories can be gauged from the fact that the companies under study had Rs. 21072 Lacks inventory holding at the end of the year 1994-95.
Further this figure represented more than 40% of the total current assets of the concerns (Table 4-2) (Appendix - I).

Table (4-2)

PERCENTAGE OF INVENTORIES TO CURRENT ASSETS IN SELECTED CEMENT FACTORIES FROM 1987-88 TO 1995-96

<table>
<thead>
<tr>
<th>YEAR</th>
<th>S.D.C</th>
<th>G.S.C</th>
<th>G.A.C</th>
<th>S.C.C</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>44.73</td>
<td>38.45</td>
<td>58.11</td>
<td>58.05</td>
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<tr>
<td>88-89</td>
<td>44.86</td>
<td>34.28</td>
<td>68.30</td>
<td>49.08</td>
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<td>89-90</td>
<td>42.36</td>
<td>38.73</td>
<td>68.45</td>
<td>34.36</td>
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<tr>
<td>90-91</td>
<td>50.41</td>
<td>39.69</td>
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<td>91-92</td>
<td>50.48</td>
<td>48.98</td>
<td>34.57</td>
<td>31.93</td>
</tr>
<tr>
<td>92-93</td>
<td>50.05</td>
<td>43.05</td>
<td>37.05</td>
<td>27.99</td>
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<tr>
<td>93-94</td>
<td>46.44</td>
<td>34.80</td>
<td>36.87</td>
<td>18.58</td>
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<tr>
<td>94-95</td>
<td>44.29</td>
<td>38.82</td>
<td>41.80</td>
<td>20.93</td>
</tr>
<tr>
<td>95-96</td>
<td>42.13</td>
<td>42.92</td>
<td>54.82</td>
<td>32.86</td>
</tr>
</tbody>
</table>

Source: compiled on the basis of Annual Reports from 1987-88 to 1995-96 for the concerned companies.

4.2.2 Objectives of Inventory Control

The Bureau of Public Enterprises has stated the following objectives of inventory control(12):

1. To reduce capital locked up.
2. To ensure that the production does not suffer
3. To ensure that sale of finished goods is not affected
4. To avoid wide fluctuations in production.
4.2.3 Technique of Inventory Control:

The techniques of inventory control consist of three types
(a) Traditional, (b) Accounting (c) Scientific.

4.2.3.1 Traditional Techniques of Inventory Control

This system consists of the following:

4.2.3.1.1 Demand and Supply Technique.

This technique depends upon the study of demand in relation to
supply in the market. It ensures the lowest cost and the lowest
possible inventory are in consonance with the requirement.

4.2.3.1.2 Minimum - Maximum System:-

It is the basic system in which (max-min) levels of quantities of
inventories to keep the stock at a time are fixed. Minimum level
is the lower limit which we can maintain as a buffer stock, while
the maximum is the upper limit which should not be allowed to be
exceeded under normal circumstances.

4.2.3.1.3 Order-cycling System:-

This system depends upon placing the order periodically. The
frequency of review generally depends upon the importance,
availability and lead time to get it again in the stock.

4.2.3.1.4 Two Bin System:-

This system is very easy, the stock of each item of inventory is
separated into two bins. The lower bin contains quantity of stock
to the order point. This quantity should be sufficient up to the
time that order is placed and the goods are delivered. The upper
bin contains a quantity of inventory equal to the difference
between the maximum and the order point.
4.2.3.1.5 ABC Analysis Technique of Inventory Control:

This technique is popularly known as Always (A) Better (B) Control (C). i.e., ABC inventory control system which is again classified into three classes of high value (A), medium value (B), and low value (C). Mayer and Boonman have divided inventory into the following three categories.

Class A: The top 5 to 10 percent of items, which account for the highest rupae inventory investment.

Class B: The middle 20 to 30 percent of items, which accounts for a moderate share of the inventory investment.

Class C: The large remaining group of stock keeping items, which account for a small fraction of total investment.

It has been discussed in detail in Chapter - II.

4.2.3.2 Accounting Techniques of Inventory Control:

How much to order and when to order is the main task for any management and also the basic problem. This techniques indicates the quantity and the time for placing the order which has to be recorded.

4.2.3.2.1 Inventory Control Records

The good store record shows us the quantity, quality and value of inventory that is maintained. It give us a clear view about the past experience and helps us in planning and control. In keeping the record, every industry may have different methods of record-keeping and maintenance of account of inventory and it is useful for the inventory management.
The different stages in inventory record are:

Receipt of inventory
Indent
Purchase Requisition Form
Purchase Order Form
Gate Entry
Goods Received Note
Inspection Report
Bin Card
Stores ledger

INVENTORY STORAGE AND ISSUE OF INVENTORY

Materials Requisitions Slip
Bin Card
Gate pass
Stores Advice Note
Materials Transfer Note
Abstract

VERIFICATION OF INVENTORY

Inventory taking sheet
Inventory valuation sheet
Stock - day sheet
Kardex card
Variance Report
Disposal of Finished Inventory
Finished stock register
Packing slip note
Gate pass
Waste Weighment Report
Daily Waste Stock Report
Waste Delivery Order
Each record is important and keeps us in touch with the real inventory and we know how much of it, we are having with us and when to order. It was observed that only a few cement companies in Gujarat keep up to date records and most other companies do not keep most of the records.

4.2.3.2.2 Value Analysis:-
Value Analysis (VA) is one of the important techniques of inventory management. According to Dean S. Ammer "value analysis is the study of the relationship of design, function, and cost of any product material or service with the object of reducing its cost through modification of design or material specification and manufacture by a more efficient process, change in source of supply, or possible elimination or incorporation into a related item". 13 We have discussed this topic in Chapter II.

4.2.3.2.3 Variance Analysis Technique:-
The control technique associated with budgeting is variance analysis. Any deviation of actual performance from planned or budgeted performance is considered as variance. Any classification, refinement, explanation or investigation of variance is referred to as variance analysis.

Inventory variances of raw materials, work in process and finished output in terms of quantity and price can conveniently be calculated with comparison to standards that have already been determined before production begins. Once variances have been
identified and measured at an appropriate level of detail, a decision must be made as to whether or not to investigate the variances further.

Variances between standard and actual performance can be investigated and reported on a selective basis. A simple decision rule for this purpose might be to establish control limits, either in absolute rupee or in percentage terms. Any variance exceeding those limits will be more fully analysed to establish its causes and if possible, to reduce or eliminate the variance.

There must be a rule to limit variance. "Any variance in excess of Rs.1,000 or greater than 5 percent of the budgeted amount, will be subject to detailed analysis"(14). When only those variances that violate control limits are reported and investigated, attention of the management can be directed first to the more important problems. This process essentially consists of three steps:

1. The investigation decision-i.e., deciding whether or not to investigate a calculated variance.

2. The investigation process which means finding the causes of those variances that are considered worth investigation.

3. The adjustment process which implies deciding what action to take in response to the ascertained cause of variance.

This could involve:

a. Taking no action

b. Adjusting the plan, budget or standard that was used to calculate the variance, or
c. Adjusting the operations of the process or the manufacturing system which is the subject of variance analysis.

The last three options correspond to conclusions that the variance has either (1) no decision significance (2) planning significance or (3) control significance.

The frequency of variance reporting influences the planning and control effectiveness of a standard costing system. If variance is likely to deviate far from the control limits, then it is critical and the variances should be reported promptly enough to allow remedial action to be taken.

In the cement companies which are under study, variances are commonly reported once a month. Considering the process cycle of the product, which is relatively brief enough, the overriding requirement is that reporting periods be short enough so that managers can make effective and economical responses to variances. Therefore, weekly or even daily variance reports may be needed.

4.2.3.2.4 Inventory Turnover Ratio:

Inventory Sales Ratio or Inventory Turnover Ratio is important in modern business. According to B. Graham and C. McGolrick "The chief criterion of inventory soundness is the turnover defined as the annual sales divided by the year end inventory"(13).

\[
\text{Inventory Turnover Ratio} = \frac{\text{Value of goods sold}}{\text{Year end inventory}}
\]

At first inspection of inventory control system, one gets the impression that the turnover rates are fixed for each item. When sales volume increases substantially, firms endeavor to increase
turnover rates. Thus inventory sales ratios vary inversely with changes in sales.

Any company can raise this ratio either by reducing inventories or by increasing sales without a corresponding increase in inventories. By dividing net sales by inventories indicates how rapidly the company is turning over its inventories. The ratios give danger signals.

**Table No. (4-3)**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>S.D.C</th>
<th>G.S.C</th>
<th>G.A.C</th>
<th>S.C.C</th>
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<td>4.30</td>
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<td>5.29</td>
<td>4.53</td>
</tr>
<tr>
<td>89-90</td>
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</tr>
<tr>
<td>91-92</td>
<td>3.22</td>
<td>4.85</td>
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<td>92-93</td>
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<td>7.89</td>
</tr>
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<td>95-96</td>
<td>2.42</td>
<td>6.90</td>
<td>5.78</td>
<td>5.86</td>
</tr>
</tbody>
</table>

Sources: APPENDIX I & II.

From the above table, we observe that the cement factories had a high inventory turnover which they improved gradually in 1996 as compared to 1988. Most of the companies have been making efforts to reduce their inventory which is in excess.
4.2.3.3 Scientific Techniques of Inventory Control:

Statistics is one of scientific methods in controlling the inventory and can be used for effective control. Demand and consumption are the key factors influencing inventory policies. Management has to forecast the future from the past behaviour of these factors.

Many Cement companies have started applying statistical methods for forecasting the future movements so as to have better inventory management and control, better purchasing, and efficient inventory planning, inventory level and quality control. The scientific techniques are legion, we will discuss the most important ones for Cement factories such as Time series analysis, correlation and regression analysis, probability and index numbers.

4.2.3.3.1 Time Series Analysis:

In Business fields, time series may relate to either the problems of internal administration like sales, purchase, profits, inventories, etc. or wider problems of analysis of general economic conditions.

Forecasting is an important technique for business planning and decision making. Managements now use the statistical technique of time series analysis for assistance in the difficult task of peeping into future.

4.2.3.3.2 Correlation and Regression Analysis:

The term correlation (or co-variation) indicates the relationship between two such variables in which, with changes in the value of one variable, the value of the other variable also changes.
Correlation and regression analysis technique are used to look at the association between two or more variables so as to predict the changes in the dependent variable when the independent variable changes. Correlation measures the strength of the relation, regression establishes the mathematical expression indicating the nature and the degree of the relationship.

In cement plant, the consumption of limestone will depend on the production of different types of cement. We can therefore extend this relationship to the demand for these products and plan the inventory requirements.

4.2.3.3.3 Probability Analysis:
Probability theory is very important in decision making under uncertainty. In the system of inventory management and control, probability theory can be successfully used in the areas of inventory forecasting and quality control.

4.2.3.3.4 Index Numbers:
This technique is also vital in decision making, forecasting, demand trend analysis of different inventory items and is used for measuring the relative change.

4.2.3.3.5 Operations Research Techniques:
Operations Research (OR) is a scientific method which was first applied to military problems that arose during World War II. Now it is commonly used in industry, business etc.
OR Method cover the following:—

1. Formulation of the problem
2. Collection of the data.
3. Constructing a mathematical model to represent the system under study.
4. Deriving a solution from the model
5. Testing the model and the solution derived from it.
6. Establishing Control over the solution.
7. Putting the solution to work—implementation.
8. Evaluate the results of the decision.

The major OR techniques that developed and applied so far to business decision making and control are:

4.2.3.3.6 QUEUEING THEORY:—

Queue is mainly applied in the fields of business (Bank, Supermarket, Booking Offices....) industries (Services of Automatic Machines, Production Line, Storage....) Engineering (Telephony Communication Networks, Electronic Computer) Transportation (Airport, Harbours, Railway, Traffic Operation in Cities, Postal Services....) and every day life.

The mechanism of a queueing process is very simple, customers arrive at service counter and are attended by one or more of the servers. Queueing system can be described as composed of customers arriving for service, waiting for service if it is not immediate, and if having waited for service, leaving the system after being served.
Characteristics of Queueing System:
1. The input process.
2. The queue discipline.
3. The service mechanism.
4. The capacity of the system.
5. Service channels.

4.2.3.3.7 Linear Programming:
Transportation model, assignment model, are used to achieve reduction in the transportation cost of inventory.

4.2.3.3.8 Net Work Analysis:
With the help of Network Diagram, determination of an optimum sequence of certain operations is made in order to minimize overall time and cost of production. In this connection, PERT (Programme Evaluation and Review Technique) and CPM (Critical Path Method) are very useful.

4.2.3.3.9 Simulation:
Simulation model for evaluating alternative courses of action under the condition of uncertainty.

4.2.3.3.10 Decision Theory:
Decision theory enables a manager to select the best course of action when information is given in probabilistic form.

4.3 INVENTORY OPERATION MODEL
Implementation of a proper inventory control system helps in keeping the investment in the inventory as low as feasible and yet ensures availability of materials by providing adequate
protection against uncertainties of supplies and consumption of materials and allows full advantage of economic of bulk purchases and transportation costs besides the control by the management over inventories. The Reserve Bank of India appointed a study group in July 1974 headed by the Chairman of Punjab National Bank, Mr. P Tandon to frame guidelines for the follow up of Bank credit. In 1975 Tandon Committee Report was published by the RBI and one of the terms of reference for the Committee was to make suggestions for prescribing inventory norms for different industries both in the public and private sectors. The Committee was of the opinion that if bank credit is to be viewed as a tool of resource allocation in the economy, one cannot get away from the need to define norms for reasonable levels of inventories (including safety stock).

The following are the norms suggested by the Tandon Committee for Cement Industry (16).

1. Raw materials (including stores and other items used in the process of manufacturing) should not exceed 2 months.
2. Stock in process also should not exceed 1/2 month
3. Finished goods should not exceed 1 month.

NOTES

A. Raw materials are expressed as so many months' consumption. They include stores and other items used in the process of manufacturing.

B. Stocks in process are expressed as so many months' cost of production.
C. Finished goods are expressed as so many months' cost of sales.

These figures represent only the average levels. Individual items of finished goods which could be different for different periods, could exceed the indicated norms so long as the overall average level of finished goods does not exceed the amount as determined in terms of the norms.

D. Stocks of spares are not included in the norms, since in financial terms, they are not significant in many industries.

Materials manager of any cement factory has to fix Economic Order Quantity (E.O.Q). Re-order point and safety stock levels for the efficient control of inventory. Inventory is the life blood of any company. We should control this inventory because excessive inventory and under inventory both are harmful economically and we should fix up the size of inventory at a reasonable level.

The main factors which influence the cost of inventory are as follows:

4.3.1 ECONOMIC ORDER QUANTITY (E.O.Q.) OR ECONOMIC LOT SIZE (E.L.S.)

This term is the same but the uses are different. According to C.R. Kothari, generally, the term EOQ is used in the context of raw material inventories and the term ELS in the context of goods-in-process inventories or finished goods inventories. (17)

Magee and Goodman had observed that "deciding how many of an item to buy or make for stock at one time is one of the most common
and still frequently unresolved questions of inventory control". (18)

Joseph Buchan and Ernest Koenigsberg said "EOQ is that order quantity which will minimise the total variable costs of managing inventory". (19)

To reduce the cost of inventory we should calculate EOQ which contains two types variable cost namely:
Ordering Costs and Carrying costs.

4.3.2 Ordering Costs:
Ordering costs is the additional cost of placing an order which is considered to be independent of the size of the order in manufacturing. This might include set-up costs, if Co is the cost of order and (q) is the order quantity, and so the unit cost of placing an order is (Co/q) and this decreases at a decreasing rate as the order quantity increases.

The annual cost of ordering can be determined by multiplying this unit ordering cost by the annual sales (E) in units. This annual ordering cost (CoE/q) decreases with increasing order quantity. From the graph, we can see that if the entire quantity is ordered at one time then the cost is less than in repetitive orders.
GRAPH (4.1)
ORDERING COSTS

Annual Ordering Cost

Order Quantity
4.3.3 Carrying Costs:

Carrying cost is the cost of physical storage of inventory plus the opportunity cost of the money tied up in inventory. According to Joseph B. Monks "These include the interest on invested capital, handling and storage, insurance and taxes, obsolescence, spoilage and any system costs such as data processing."

The cost of carrying an item in inventory is usually expressed as a percentage of the unit purchase cost of the item and in relation to a certain period of time such as 20% per year.

If \( (Cu) \) Carrying Cost - is the unit cost of an item and \( (IO) \) is the annual carrying cost by percentage, then \( (Cu) \) is annual carrying cost. The carrying cost is based on the average of the inventory - one half of the order quantity - then \( (Cu) \ q/2 \) is the carrying cost we can see that in graph No. (4-2).

From the graph (4-1), ordering cost curve is taken and from the graph (4-2), carrying cost curve is taken and both these curves intersect each other at point EOQ. As a result of these two curves, we get the order quantity curve and corresponding to the point EOQ, we get the pt. A on the order Quantity curve.

Thus after joining the points in (4-1) and (4-2), we get (4-3) and the total annual cost curve is found to be rather flat near the minimum point, reflecting the square root relationship in the formula for \( Q \). Thus the reorder quantity can be varied over some range near the minimum without significantly changing the total cost.
GRAPH (4-2)
Inventory Carrying Cost

Order Quantity

Annual Cost

0 10 20 30 40 50 60 70 80 90 100
4.3.4 RE-ORDER POINT:

For any attempt to design inventory control systems, we have to start with the determination of EOQ. This system indicates the quantity to be ordered, and not when to place the order. There are two ways to determine the re-order point, first by Fixed Order Quantity System and second by Replenishment Order control system.

The inventory model is very simple and has proved widely useful. It is a classical model having first appeared in the literature more than sixty years ago. This model is a "fixed order quantity" model. This is referred to as the Wilson Formulation. The inventory Reorder Quantity is fixed and a reorder is placed whenever the inventory on hand drops to a particular level, referred to as the reorder point.
4.3.5 The Fixed Re-order Quantity Model

Modern concepts of inventory management can be traced to the period 1915-22 when several authors, acting independently, developed an economic lot size equation which minimized the sum of carrying cost and holding cost for cases where the demand was known and constant. R H Wilson developed this work in succeeding years and his name is still associated with the fixed re-order point policy. These early models of inventory behaviour had little development and few applications until after World War II.

The extensive development of inventory theory and its application date from 1950 or so;

There are many models for inventory control and management which answer the questions:

(1) When do we buy, (2) How much do we buy? Our answer in terms of the re-order point P and the order quantity Q can take the following form:-

1. Q fixed, P fixed (fixed order quantity)
2. Q fixed, P variable (replenishment of a fixed quantity)
3. Q variable, P fixed (optional replenishment)
4. Q variable, P variable (replenishment policy)

4.3.6 Fixed Order Quantity:-

It is more frequently referred to as "Wilson Formulation". This system 'model' is the basic inventory model in which the order quantity is fixed and order or re-order is placed whenever the inventory level touches a certain level, known as the re-order point.
This model is more concerned with cost analysis and it analyses the costs of managing an inventory, and using these costs to determine the fixed order quantity for some item and its timings for order or re-order.

The main thing in this model is the total cost of managing the inventory by two factors (a) cost of ordering and (b) Cost of carrying.

(a) Cost of Ordering:
This is the cost which depends upon the size of ordering and the cost of placing an order in the manufacturing industries which includes its set-up cost.

(b) Costs of Carrying:
These costs are connected with the storage of an inventory plus the opportunity cost of money tied up in holding it. Usually the costs are expressed by percentage per annum.

We have discussed carrying and ordering costs in this chapter.

4.3.7 Replenishment Models

Replenishment methods are effective in many real inventory situations, particularly when delivery lead time is long and shortage costs are extremely high or when stock counts are infrequent. Sometimes called it is a maximum liability model. The replenishment method is one in which a maximum inventory level is set and either single units are ordered to replace items sold or, if orders are placed periodically, the amount sold since the last order is replaced.
In the replenishment method, there is only one number to be determined. \( M \), the base stock or maximum inventory level. Let \( \bar{D} \) be the mean weekly demand, \( L \) the mean lead time in weeks, \( R \) the inventory review time in weeks, and \( B \) the buffer stock in units. \( M \) must certainly be larger than \( L\bar{D} \), which is just sufficient to meet average demands until the ordered good arrives. We therefore set.

\[
M = (R + L) \bar{D} + B \quad \ldots \quad (1)
\]

and if \( I \) is the inventory at a review time, we order a quantity \( Q \) given by

\[
Q = M - I \quad \ldots \quad (2)
\]

Equation (2) holds when the lead time is shorter than the review time. When the reverse is true that is, when \( L > R \) we have

\[
Q = M - I - T
\]

When \( T \) is the number of units in transit.

The buffer stock \( B \) must be sufficient to guarantee an adequate service level in the face of variations in both demands and lead time.

If we take the replenishment time as being the total of lead time and review time and have a measure of the distribution in demand over this time interval, we can use the formula to obtain

\[
E = \text{CoS} + \text{BC}
\]

Value of \( B \) which yields the appropriate service level (3)

\[
Z = \frac{\text{Number of units shipped (without delay)}}{\text{Number of units demanded}}
\]
When lead times are long compared to review times, larger buffer stocks are required than in the case where the reverse is true.

4.3.8 Optional Replenishment Method (S,s) method

This method is based upon two mathematical formulas which were used in conjunction with decision rules to determine "when" and "How much" to buy. "When" to buy was determined by the actual inventory falling to or below, a particular level called the reorder point. "How much" to buy was determined by the relation of actual inventory to a particular level called the maximum stock level, also called M or replenishment level. It will be remembered that systems in which the reorder quantity is not fixed, but varies according to the difference between a fixed level and the actual inventory level at the time of accounting, are called replenishment level methods. The optional replenishment level method is used here, because an order was placed only if the inventory level dropped to a reorder point which was substantially below the M level. The two formulas used for computing the individual reorder and replenishment levels are

\[ P = B + Sw \cdot (L + 1/2) \]  \hspace{1cm} \ldots (3-1) \\
\[ M = P + KSw \]  \hspace{1cm} \ldots (3-2) \\

where P = reorder point

M = maximum stock level

Sw = Weekly shipments to stores

L = average lead time from vendor

B = buffer stock

K = Order cycle constant
A two-bin method is defined as any policy which generates an order when the inventory level falls to a prescribed value, it is named as (S, s) method.

4.3.9 Choice of a System:

All the three of the systems discussed occur with a multitude of minor variations, which we will not attempt to appraise in discussing the basis for choosing a particular system. In general, the fixed order quantity system finds its largest application where close control is not necessary because of low activity and/or the value of the item is low with low activity. The fixed reorder quantity system defers action until an order of reasonable size can be placed, thus recognizing the possible importance of incremental ordering costs. The fixed order quantity system requires an accurate perpetual inventory record or its equivalent so that it is possible to determine when the order point has been reached without significant delay. Where suppliers require some minimum size total order or package quantity restrictions, we have some difficulty with the fixed order quantity system, since it treats each inventory item individually as order points are reached. The result is that though many different orders (for different items) may go to the same supplier over a period of time, they are seen as relatively small individual orders shipped individually at relatively high freight cost.

The fixed reorder cycle system makes it possible to group orders for a number of individual items from one supplier and it becomes possible to take advantage of low shipping cost with carload
cost. The fixed cycle system has a quick response to demand changes and is in general applicable for high-activity situations where close surveillance over both demand and inventory levels is of importance. On the other hand, the fixed reorder cycle system requires larger safety stocks, since we must provide for the possibility of stock-out over the longer R+L period instead of only as in the fixed order quantity system. In general, the costs of maintaining the fixed reorder cycle system will be higher because of the larger buffer stock and the cost of making the periodic reviews. While it is possible to determine optimal review periods for each item, it will normally be advantageous to set a common review period for all items or for classifications of items in order to gain the advantages of grouping orders to common suppliers. The result is that little attention is given to optimal review periods. Instead, review periods are set based on other considerations.

The optional replenishment system seems to combine the significant advantages of the other two systems. It has probably not gained predominance in practice because the mathematical analysis is very complex and somewhat more information is required to operate such a system.

4.4 Inventory Structures in Cement Factories:-

The inventory in cement factories with special reference to Gujarat has been studied by classifying their "aggregate inventory" - Appendix - I, into five classes: Raw materials, spare parts, goods-in-process, finished goods and miscellaneous packing materials.
4.4.1 Raw Materials:

From Table (4-4) we can observe that the share of raw materials to "Aggregate Inventory" was very significant in the cement factories. The proportion of raw materials as the percentage of "aggregate inventory" has the tendency to go up. The percentage share of raw materials for all the cement factories taken together to their total aggregate inventory was only 7.41 percent in the year 1987-88 but it had gone up to 9.88 percent and 22.15 percent in the years 1994-95 and 1995-96 respectively.

The absence of norms both for the consumption and stocking of various raw materials in all the selected cement factories had mainly been responsible for the increase in the proportion of raw materials.

This points out that the cement factories did not follow a system of scientific control of raw materials inventory.
Table (4-4)

EXTENT AND PERCENTAGE OF RAW MATERIALS TO "AGGREGATE INVENTORY" IN SELECTED CEMENT FACTORIES FROM 1987-88 TO 1995-96 (Rs. in lacs)

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C</th>
<th>G.S.C</th>
<th>B.A.C</th>
<th>S.C.C</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>033 (0.94)</td>
<td>323 (48.87)</td>
<td>190 (13.95)</td>
<td>0173 (13.87)</td>
</tr>
<tr>
<td>88-89</td>
<td>065 (1.89)</td>
<td>042 (04.66)</td>
<td>149 (08.36)</td>
<td>0091 (07.55)</td>
</tr>
<tr>
<td>89-90</td>
<td>093 (2.68)</td>
<td>007 (00.75)</td>
<td>152 (10.71)</td>
<td>0147 (13.35)</td>
</tr>
<tr>
<td>90-91</td>
<td>105 (2.15)</td>
<td>006 (00.53)</td>
<td>197 (10.31)</td>
<td>0381 (23.32)</td>
</tr>
<tr>
<td>91-92</td>
<td>053 (0.86)</td>
<td>083 (03.90)</td>
<td>320 (10.54)</td>
<td>0487 (26.17)</td>
</tr>
<tr>
<td>92-93</td>
<td>052 (0.82)</td>
<td>022 (00.86)</td>
<td>306 (00.75)</td>
<td>0395 (23.38)</td>
</tr>
<tr>
<td>93-94</td>
<td>120 (2.09)</td>
<td>049 (02.13)</td>
<td>205 (03.74)</td>
<td>0379 (15.77)</td>
</tr>
<tr>
<td>94-95</td>
<td>058 (1.09)</td>
<td>046 (01.67)</td>
<td>286 (03.26)</td>
<td>0549 (23.79)</td>
</tr>
<tr>
<td>95-96</td>
<td>104 (1.84)</td>
<td>201 (05.46)</td>
<td>616 (04.80)</td>
<td>1228 (36.63)</td>
</tr>
</tbody>
</table>

Source: Appendix - I
Note: Figures in brackets show the percentage of raw materials to "aggregate inventory".

Individually, the percentage share of raw materials to "aggregate inventory" was found lower in some companies than in other companies. Raw materials formed a low percentage in some companies because most of their raw materials were being procured from indigenous sources.

In order to find out the extent of overstocking in raw materials, the raw materials inventory in terms of months' value of materials consumption has been calculated (Table 4-5).
Table (4-5)

RAW MATERIALS INVENTORY IN TERMS OF MONTHS VALUE
OF RAW MATERIALS CONSUMPTION IN SELECTED CEMENT
FACTORIES FROM 1987-88 TO 1995-96

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>S.S.A.</th>
<th>S.A.C.</th>
<th>S.E.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>2 DAYS</td>
<td>N.A</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>88-89</td>
<td>4 DAYS</td>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>89-90</td>
<td>6 DAYS</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>90-91</td>
<td>6 DAYS</td>
<td>7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>91-92</td>
<td>2 DAYS</td>
<td>10</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>92-93</td>
<td>3 DAYS</td>
<td>10</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>93-94</td>
<td>1 DAY</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>94-95</td>
<td>3 DAYS</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>95-96</td>
<td>7 DAYS</td>
<td>4</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

Source: Appendix I(a) and II(a)

This table indicates that the raw materials inventory in terms of months’ value of raw materials consumption for all the cement factories together had increased from the level of 24 months in the year 1987-88 to 29 months in the year of 1995-96.

4.4.2 Work-in-Process:

From Table (4-6) we observe that goods-in-process also occupied an important place in the structure of aggregate inventory relating to selected cement factories. The percentage of this component of inventory for all the cement factories taken together had risen from 3.68 in the year 1987-88 to 14.76 in the year 1994-95. This fact explicitly demonstrates that no serious steps were taken to arrest its growth.
Table (4-6)

EXTENT AND PERCENTAGE OF GOODS-IN-PROCESS TO AGGREGATE INVENTORY IN CEMENT FACTORIES FROM 1987-88 TO 1995-96

(Rs. in Lacs)

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>G.S.C.</th>
<th>G.A.C.</th>
<th>S.C.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>0337 (10.39)</td>
<td>0094 (14.22)</td>
<td>0166 (12.19)</td>
<td>0189 (15.16)</td>
</tr>
<tr>
<td>88-89</td>
<td>0357 (10.35)</td>
<td>0180 (19.19)</td>
<td>0116 (06.51)</td>
<td>0141 (11.69)</td>
</tr>
<tr>
<td>89-90</td>
<td>0332 (10.12)</td>
<td>0209 (22.40)</td>
<td>0033 (02.33)</td>
<td>0071 (06.45)</td>
</tr>
<tr>
<td>90-91</td>
<td>0650 (13.34)</td>
<td>0146 (12.87)</td>
<td>0059 (03.04)</td>
<td>0094 (05.75)</td>
</tr>
<tr>
<td>91-92</td>
<td>1266 (20.64)</td>
<td>0400 (18.79)</td>
<td>0290 (09.53)</td>
<td>0437 (23.48)</td>
</tr>
<tr>
<td>92-93</td>
<td>1264 (20.00)</td>
<td>0504 (19.74)</td>
<td>1138 (23.86)</td>
<td>0296 (11.63)</td>
</tr>
<tr>
<td>93-94</td>
<td>0876 (15.17)</td>
<td>0446 (19.37)</td>
<td>0962 (17.55)</td>
<td>0594 (24.72)</td>
</tr>
<tr>
<td>94-95</td>
<td>0979 (18.32)</td>
<td>0683 (24.79)</td>
<td>0662 (07.53)</td>
<td>0331 (13.84)</td>
</tr>
<tr>
<td>95-96</td>
<td>0732 (13.31)</td>
<td>0293 (7.96)</td>
<td>1740 (13.56)</td>
<td>0449 (13.39)</td>
</tr>
</tbody>
</table>

Source: Appendix I  Note: Figures in brackets show the percentage of goods-in-process to aggregate inventory.

When seen individually it is revealed that work-in-process was of a very small size. The measurement of the goods-in-process in terms of days value of production further did not reaffirm this conclusion.
### Table (4-7)

**WORK-IN-PROCESS INVENTORY IN TERM OF MONTHS**

**VALUE OF W-I-P. CONSUMPTION IN SELECTED CEMENT FACTORIES FROM 1987-88 TO 1995-96**

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>G.S.C.</th>
<th>B.A.C.</th>
<th>S.C.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88-89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>89-90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90-91</td>
<td>18 days</td>
<td></td>
<td>1 DAY</td>
<td></td>
</tr>
<tr>
<td>91-92</td>
<td>22 DAYS</td>
<td></td>
<td>6 DAYS</td>
<td></td>
</tr>
<tr>
<td>92-93</td>
<td>26 DAYS</td>
<td>13 DAYS</td>
<td>24 DAYS</td>
<td></td>
</tr>
<tr>
<td>93-94</td>
<td>16 DAYS</td>
<td>10 DAYS</td>
<td>10 DAYS</td>
<td>11 DAYS</td>
</tr>
<tr>
<td>94-95</td>
<td></td>
<td>13 DAYS</td>
<td>6 DAYS</td>
<td>5 DAYS</td>
</tr>
<tr>
<td>95-96</td>
<td></td>
<td>4 DAYS</td>
<td>8 DAYS</td>
<td></td>
</tr>
</tbody>
</table>

Source: Appendix I(b) & III (a)

#### 4.4.3 SPARE PARTS:

We can reduce the inventories up to 50 percent if we reduce the amount of spare parts, from the Table (4-8), we can see that the maximum amount of the selected cement factories. In Shree Digvijay, the percentage of spare parts to aggregate inventories was 28.1 percent in 1987-88 and it increased up to 29.85 percent in 1995-96. In Gujarat Sidhee, it was 21.94 percent in 1987-88 and shot up to 68.31 percent in 1995-96. In Gujarat Ambuja, proportion was 55.07 in 1987-88 and it became 83.83 percent and 77.73 percent in 1990-91 and 1995-96 respectively.

The only company under study with with spare parts decreased is Saurashtra Cement, it was 57.98 percent in 1987-88 and decreased
to 37.89 percent in 1995-96. Shree Digvijay contained 14.8 percent of the aggregate spare parts, while Gujarat Sidhee had 16.65 percent. The highest one in this respect factories under study is Gujarat Ambuja which accumulated up to 55.83 percent of it, while Saurashtra Cement has the lowest proportion with 12.72 percent.

TABLE (4-8)

EXTENT AND PERCENTAGE OF STORES AND SPARE-PARTS TO "AGGREGATE INVENTORIES" IN SELECTED CEMENT FACTORIES FROM 1987-88 TO 1995-96.

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>G.S.C.</th>
<th>S.A.C.</th>
<th>S.C.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>949 (28.10)</td>
<td>143 (21.94)</td>
<td>750 (55.07)</td>
<td>723 (57.98)</td>
</tr>
<tr>
<td>88-89</td>
<td>976 (27.87)</td>
<td>388 (42.92)</td>
<td>1315 (73.79)</td>
<td>692 (57.33)</td>
</tr>
<tr>
<td>89-90</td>
<td>974 (19.98)</td>
<td>498 (53.34)</td>
<td>1153 (81.13)</td>
<td>698 (63.40)</td>
</tr>
<tr>
<td>90-91</td>
<td>985 (16.06)</td>
<td>781 (68.87)</td>
<td>1602 (83.83)</td>
<td>786 (48.10)</td>
</tr>
<tr>
<td>91-92</td>
<td>1281 (20.27)</td>
<td>1238 (58.15)</td>
<td>2253 (74.21)</td>
<td>842 (45.24)</td>
</tr>
<tr>
<td>92-93</td>
<td>1512 (26.36)</td>
<td>1502 (58.83)</td>
<td>3166 (66.37)</td>
<td>1039 (41.61)</td>
</tr>
<tr>
<td>93-94</td>
<td>1432 (26.80)</td>
<td>1410 (61.23)</td>
<td>3538 (64.54)</td>
<td>1083 (45.07)</td>
</tr>
<tr>
<td>94-95</td>
<td>1486 (27.61)</td>
<td>1627 (59.06)</td>
<td>7018 (79.88)</td>
<td>1105 (46.20)</td>
</tr>
<tr>
<td>95-96</td>
<td>1687 (29.85)</td>
<td>2351 (68.31)</td>
<td>9971 (77.73)</td>
<td>1270 (37.89)</td>
</tr>
</tbody>
</table>

Sources: Appendix I Note: Figures in brackets show the percentage of spare parts to aggregate inventories.

With another look to table (4-9) for the cement factories taken together, it is found that the stock of stores and spare parts is greater than the reasonable limit in Gujarat Ambuja and Saurashtra Cement.

"The holding of the stores and spares should not exceed 12 months consumption level in any public enterprises." (22).
### Table (4-9)

**STORES AND SPARE-PARTS INVENTORY IN TERMS OF MONTHS**

**VALUE OF STORES AND SPARE-PARTS CONSUMPTION IN SELECTED CEMENT FACTORIES FROM 1987-88 TO 1995-96**

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>G.S.C.</th>
<th>G.A.C.</th>
<th>S.C.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>04</td>
<td>n.a</td>
<td>27</td>
<td>86</td>
</tr>
<tr>
<td>88-89</td>
<td>04</td>
<td>05</td>
<td>39</td>
<td>51</td>
</tr>
<tr>
<td>89-90</td>
<td>08</td>
<td>08</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>90-91</td>
<td>19</td>
<td>09</td>
<td>41</td>
<td>20</td>
</tr>
<tr>
<td>91-92</td>
<td>13</td>
<td>11</td>
<td>55</td>
<td>14</td>
</tr>
<tr>
<td>92-93</td>
<td>13</td>
<td>10</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>93-94</td>
<td>22</td>
<td>11</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>94-95</td>
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<td>10</td>
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</tr>
<tr>
<td>95-96</td>
<td>10</td>
<td>15</td>
<td>48</td>
<td>27</td>
</tr>
</tbody>
</table>

*Source: Appendix I and III*

#### 4.4.4 FINISHED GOODS:

From Table (4-10), we can see that both the extent and percentage of finished goods to aggregate inventory were very high in the cement factories. Though the percentage share of finished goods to aggregate inventory in the selected factories had declined from 7.69 percent in 1987-88 to 12.68 percent in 1995-96, it was very high in some factories.
# Table (4-10)

EXTENT AND PERCENTAGE OF FINISHED GOODS TO AGGREGATE INVENTORY IN CEMENT FACTORIES FROM 1987-88 TO 1995-96

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>S.S.C.</th>
<th>G.A.C.</th>
<th>S.C.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>1508 (43.88)</td>
<td>098 (14.83)</td>
<td>296 (16.80)</td>
<td>123 (09.86)</td>
</tr>
<tr>
<td>88-89</td>
<td>1508 (43.72)</td>
<td>293 (32.41)</td>
<td>200 (11.22)</td>
<td>192 (15.92)</td>
</tr>
<tr>
<td>89-90</td>
<td>1448 (41.65)</td>
<td>218 (23.37)</td>
<td>080 (05.64)</td>
<td>114 (10.39)</td>
</tr>
<tr>
<td>90-91</td>
<td>1919 (39.37)</td>
<td>200 (17.64)</td>
<td>054 (02.83)</td>
<td>173 (11.18)</td>
</tr>
<tr>
<td>91-92</td>
<td>2037 (33.20)</td>
<td>407 (19.12)</td>
<td>173 (05.70)</td>
<td>318 (17.09)</td>
</tr>
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<td>92-93</td>
<td>1993 (31.53)</td>
<td>524 (20.52)</td>
<td>160 (03.35)</td>
<td>142 (05.58)</td>
</tr>
<tr>
<td>93-94</td>
<td>2100 (36.61)</td>
<td>396 (17.20)</td>
<td>739 (13.48)</td>
<td>245 (10.20)</td>
</tr>
<tr>
<td>94-95</td>
<td>1403 (26.25)</td>
<td>398 (14.45)</td>
<td>659 (07.50)</td>
<td>316 (13.21)</td>
</tr>
<tr>
<td>95-96</td>
<td>1758 (31.11)</td>
<td>672 (18.25)</td>
<td>500 (05.90)</td>
<td>338 (10.09)</td>
</tr>
</tbody>
</table>

Source: Appendix I and III

Generally, in cement factories there should have been no finished goods inventory because, they also use to send the finished goods direct to the different agents.
### TABLE (4-11)

**FINISHED GOODS INVENTORY IN TERMS OF MONTHS VALUE IN SELECTED CEMENT FACTORIES FROM 1987-88 TO 1995-96.**

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>G.S.C</th>
<th>G.A.C</th>
<th>S.C.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>2.0</td>
<td>n.a</td>
<td>10 days</td>
<td>8 days</td>
</tr>
<tr>
<td>88-89</td>
<td>2.0</td>
<td>n.a</td>
<td>8 days</td>
<td>13 days</td>
</tr>
<tr>
<td>89-90</td>
<td>2.0</td>
<td>n.a</td>
<td>3 days</td>
<td>6 days</td>
</tr>
<tr>
<td>90-91</td>
<td>2.0</td>
<td>n.a</td>
<td>1 day</td>
<td>7 days</td>
</tr>
<tr>
<td>91-92</td>
<td>1.2</td>
<td>n.a</td>
<td>4 days</td>
<td>9 days</td>
</tr>
<tr>
<td>92-93</td>
<td>2.0</td>
<td>3 days</td>
<td>1 day</td>
<td>3 days</td>
</tr>
<tr>
<td>93-94</td>
<td>1.5</td>
<td>7 days</td>
<td>8 days</td>
<td>5 days</td>
</tr>
<tr>
<td>94-95</td>
<td>1.0</td>
<td>8 days</td>
<td>6 days</td>
<td>5 days</td>
</tr>
<tr>
<td>95-96</td>
<td>1.5</td>
<td>10 days</td>
<td>2 days</td>
<td>6 days</td>
</tr>
</tbody>
</table>

**Source:** Appendix I AND III

#### 4.4.5 Miscellaneous Goods (packing materials, oil and fuel):

From the following Table (4-12) we can observe that the miscellaneous goods are used in cement factories. Some factories are writing the packing materials, oil and fuel separately some of them are writing it included with raw materials and some time with store and spare parts.
### Table (4-12)

**EXTENT AND PERCENTAGE OF MISCELLANEOUS GOODS TO AGGREGATE INVENTORY IN CEMENT FACTORIES FROM 1987-88 TO 1995-96**

<table>
<thead>
<tr>
<th>Year</th>
<th>S.D.C.</th>
<th>S.S.C.</th>
<th>S.A.C.</th>
<th>S.L.C.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>87-88</td>
<td>570 (16.88)</td>
<td>n.a</td>
<td>n.a</td>
<td>0.39 (0.13)</td>
<td>0.0609</td>
</tr>
<tr>
<td>88-89</td>
<td>550 (15.93)</td>
<td>n.a</td>
<td>n.a</td>
<td>0.90 (0.46)</td>
<td>0.0640</td>
</tr>
<tr>
<td>89-90</td>
<td>410 (17.54)</td>
<td>n.a</td>
<td>n.a</td>
<td>0.71 (0.45)</td>
<td>0.0681</td>
</tr>
<tr>
<td>90-91</td>
<td>1215 (24.93)</td>
<td>n.a</td>
<td>n.a</td>
<td>1.80 (11.02)</td>
<td>1.395</td>
</tr>
<tr>
<td>91-92</td>
<td>1498 (24.41)</td>
<td>n.a</td>
<td>n.a</td>
<td>0.30 (0.61)</td>
<td>1.328</td>
</tr>
<tr>
<td>92-93</td>
<td>1050 (16.61)</td>
<td>n.a</td>
<td>n.a</td>
<td>4.33 (17.80)</td>
<td>1.503</td>
</tr>
<tr>
<td>93-94</td>
<td>1208 (21.06)</td>
<td>n.a</td>
<td>n.a</td>
<td>1.02 (0.24)</td>
<td>1.310</td>
</tr>
<tr>
<td>94-95</td>
<td>1418 (26.55)</td>
<td>n.a</td>
<td>n.a</td>
<td>0.71 (0.97)</td>
<td>1.409</td>
</tr>
<tr>
<td>95-96</td>
<td>1399 (24.05)</td>
<td>n.a</td>
<td>n.a</td>
<td>2.67 (0.97)</td>
<td>1.629</td>
</tr>
</tbody>
</table>

**Source:** Appendix I

**Note:** Figures in brackets show the percentage of Miscellaneous Goods to aggregate inventory.

### 4.4.6 Type of Inventory

According to Lamar and Donald, Inventories are classified into four types. The first type is production inventory which includes raw materials, parts and components which enter into the production process.

The second type of inventories is MRO inventories. Maintenance, repair, and operating require these materials which are consumed in the production process and is not part of production.

The third type is in-process inventories: The goods which are semi-finished products are parts of the final production and it is another type of inventories.
The fourth and last type of inventories is that of finished goods. The finished goods are ready for shipment. This type of inventories is too small in cement factories because most of the finished goods are shipped within a definite time period to different agents.

The inventories which have been studied in selected cement factories have shown that the components varied from factory to factory in cement factories stores, like S.D.C. some of them have recording inventory which included the stocks of raw material and components, stores and spare parts, loose tools, packing materials, fuel, finished items, work-in-process. The G.A.C. incorporated this term the stocks of raw materials and components, stores and spare work-in-process, finished good, fuel and foureas oil.

In S.C.C., inventory included stocks of raw material, fuel, oil, coal, packing material, stores and spare parts, work-in-process and finished goods.

4.5 Conclusion
Cement industry in Gujarat has been following the provisions of the Indian Companies Act, 1956 in regard to inventory control. Inventory records help to solve the basic problems of inventory control by giving timely information both in quantity and money terms but different plants have adopted different methods of records keeping and maintenance of inventory accounts. It is, therefore, suggested that all the cement plants in Gujarat as far as possible should adopt uniform records system.
There are some items of inventory which need some special accounting treatment. Such items are goods in transit, purchase orders, consignments, and pledged or hypothecated goods. It is suggested that inventory in transit and inventory in stock should be shown separately in financial statements. Issued purchase orders are not part of inventory and, therefore are not included in the inventory. As such, it is suggested that purchase orders for which commitments have been made should be shown as a footnote in the balance sheet. Further, it will be good practice if goods on consignment are valued at cost plus reasonable expenses basis and not on contract basis. Presentation of hypothecated or pledged inventory items in the balance sheet in a more informative manner is suggested as it will be beneficial for the investors and other users of financial statements and also for those responsible for controlling the inventories.

There are various accounting techniques of inventory control. Such as value analysis, calculation of inventory ratio, variance analysis etc. But, these techniques are rarely used in some of the companies under study. These techniques are now-a-days being widely used by several industries and the cement industry should not lag behind. We have been introducing these techniques in the concerned study gradually.

Alongwith the above mentioned accounting techniques of inventory control, statistical techniques like probability theory, correlation and regression analysis, time series analysis, index number, operations research techniques also can be used. All the
The above mentioned technique are very important and useful to business organisations for making better decisions, better co-ordination and better control.
REFERENCES

1. PUBLIC ENTERPRISES SURVEY 1979-80, Annual Report on the working of industrial and commercial undertakings of the Central Govt.


6. WIGHT O.W., "Dictionary of Production and Inventory Control Terms.", American Production and Inventory Control Society, Chicago, 1966


11. BUREAU OF PUBLIC ENTERPRISES, "Guidelines for materials Management in Public Enterprises", N. Delhi, 1979


