Over view of cement plant engineering essay

Engineering

Chapter 6

Now a day’s cement has emerged as one of the important requirements in the field of construction. Cement is manufactured after undergoing several operations and get processed by various equipment such as Raw Mill , Kiln , Coal Mill and Cement Mill. The process of Cement manufacturing is further grouped asRaw material handlingRaw material grindingCoal handlingCoal grindingPyro-processCement grindingCement packing

6. 2 Cement manufacturing process

Cement industry makes use of many raw materials in the manufacturing process of cement such as Bauxite, Iron ore, Late rite, Gypsum, Limestone and coal etc. Ordinary Portland cement is produced by grinding cement clinker in association with gypsum (3-5%) to specified fineness depending on the requirements of the cement consumers. Cement clinker is produced on large scale by heating finely pulverized materials at very high temperature up to 1450°C in rotary kilns. In the materials obtained from the earth are properly proportioned to get a suitable ratio of lime (CaO), Silica (SiO2), Alumina (Al2O3) and Iron (Fe2O3) are present in the form of mixture in different proportions. As the raw materials are obtained directly from limestone and clay mines, along with this minor constituents like Magnesia, Sodium, Potassium, Sulphur, Chlorine compounds etc., may also be present in the raw materials up to limited extent which do not adversely affect either the manufacturing process or the quality of cement produced. Limestone is the major raw material used in the manufacturing of cement. Therefore cement units are necessarily located near the cement grade limestone deposit. The important unit operations involved in cement manufacturing

process include Grinding, Mining, Crushing, Pre-homogenization and Final Blending of raw materials for preparation of kiln feed.

6. 3 Introduction

The productivity of any manufacturing organization depends on the availability of raw materials and other component parts in the proper quantity, quality, price range, and time. Proper control over inventories provides the management with flexibility in making purchases systematically rather than buying strictly according to the production schedule and hand to mouth supplies. Efficient management aims at increasing the level of inventories as long as the resulting economies and benefits exceed the total cost of holding such inventories. Proper control over inventories improves the productivity and profitability of the enterprises. It also helps in achieving higher return on investment by minimizing locked up working capital and also improving the cash flow and liquidity position. The basic objective of inventory management is to optimize the size of inventory in a firm so that the smooth performance of production and sales functions may be possible at minimum cost. Inventories, Transportation and Facilities considered to be the important tools of supply chain management. The efficiency of any manufacturing sector can be drastically improved with the development of the above said tools. Inventory is one of the key determinants of the productivity of cement industry. The productivity of the cement industry is judged by its capacity utilization and economical use of major inputs such as limestone, coal, gypsum, stores, spares, and power consumption per ton of cement production. Inventory management plays an important role in the cement industry both in production of new assets and operational

maintenance of existing assets. Therefore, the continuous availability of inventory is a prime requirement for the uninterrupted working and better capacity utilization. To effectively manage inventory levels, it is essential to consider the appropriate reorder points as well as the optimized ordering quantity at that reorder point for the inventory items. This proposed system uses the Genetic Algorithm to find the optimized ordering quantity at proper reorder point by considering some of the critical raw materials that are used in " INDIA CEMENTS LIMITED". The author in the proposed work has selected 4 raw materials that are used in INDIA CEMENTS LIMITED and the average demand for a duration of one year is considered. The suppliers who supplies the raw materials along with the purchasing cost, transportation cost, holding cost, shortage cost and order cost are considered for generating the optimized ordering quantity at proper reorder point. The proposed system is also used to find the optimized usage of the facility of the manufacturing unit and it also finds the best routed supplier with minimum routing cost.

6. 4 Details of Raw material

Following are the list of raw materials used in INDIA CEMENTS and the monthly demand in Tones of each raw material is listed below. Table: 6. 1 Demand rate of Raw materialsRaw materialsM1M2M3M4M5M6M7M8M9M10M11M12Bauxite2500200015003000350020003000150025003000400018001ron Ore150020002200300035002800150027002000270038002300Laterite851002000150507080100130150751l0Gypsum27503200250020003000350025003500250015003500250Table: 6. 2 Details of various CostSl. NoRaw MaterialPurchasing cost per TonTransportation Cost/TUnloading Cost/TTotal

Cost/THolding Cost/T (5% of T. c)Shortage cost/ T (4% of T. c)1Bauxite500/-400/-10/-910/-45. 50/-36. 40/-2Iron Ore600/-500/-17/-117/-55. 85/-44. 68/-3Laterite500/-1100/-17/-1617/-18. 85/-64. 68/-4Gypsum550/-400/-10/-960/-48/-38. 40/-Table: 6. 3 Purchasing and supplier details of various raw materials

S. no

Raw materials

supplier

Quantity(Tons)

1BauxiteSri Ganesh enterprises10, 300Sri lakshmi transport10, 000Venkatesh enterprises5, 000Ksk transport5, 000Total30, 3002Iron oreVenkatesh enterprises12, 000K r r transport8, 000Sri lakshmi transport5, 000Siddhartha Transport5, 000Total30, 0003LateriteK r r transport400Siddhartha transport300Ganesh enterprises150Ksk transport250Siva shakti transport100Total12004GypsumGanesh enterprises4100Siva shakti transport3000Ksk Transport25900Total33000Grand total of Raw materials94500

6. 5 Finding minimum routing cost supplier

The Generation of optimized ordering quantity at proper re-order point and improving the ordering quantity according to the facility of the manufacturing unit along with best routed supplier having minimum routing cost by using Genetic algorithm has been applied practically by taking India Cements as a case. This research also finds the best routed supplier for ordering the products. Let ‘ MN’ be the manufacturing system which uses the

raw materialsR = { R1 , R2 , R3 .... Rn} for production and these raw materials are shipped from the suppliers S = { S1 , S2 , S3 .... Sn }. The demand rate of each raw material for the preceding period is forecasted to determine the optimized amount M of order and optimized reorder point of ' MN ' for the period of M = { M1, M2,.... Mk } 1 6. 5. 1 Finding the Efficient Facility Matrix. The forecasted demand rate D1 is used to create the associated solution demand matrix D2={D2ij C; i= 1,..,| R|; 1 Parameters: Mk ☾ MonthsD2(kj) ☾ Ordering quantity of ith raw material for the kth month. Rej ☾ Reducing amount

Pseudo code:

For each Mk Є MSet Sk =∑D2kiSet countk = no of positive order for kth monthSet Rek = Sk/countkFor each D2kiIf positive order and Sk > CΔD2ki = D2ki -Rek

End If

End For

Pseudo code : 1 process of finding agreeable efficient facility

6. 5. 2 Finding the Best Routed Supplier

The manufacturing unit purchases the raw materials 'R' from the supplier 'S' that are needed for production. Each supplier has the different routing cost for shipping the product from the supplier plant to the manufacturing unit. The same raw material may have the different routing cost among the various suppliers. The table 6. 4 illustrates the sample best chromosome which represents the optimized reorder point of the raw materials for the ' 12' months. The table 6. 5 represents that the raw materials to be purchased

for the month ‘ M1’ is ‘ R1’, The ‘ 1’ in the table represents the positive ordering status of the raw material and ‘ 0’ represents the negative ordering status of the raw material. Let PRki; i= 1.. 10 be the set of the raw materials to be purchased for the Kth month, where k= 1...10, SC={SCi; i= 1.. S} be the set of raw materials that are supplied by the each supplier where SCi={Rj ; jЄ1.. 10} is raw materials supplied by the ith supplier and RC={RCij; jЄ1.. 10} is the routing cost of the raw materials supplied by the ith supplier. From the table 6. 4 the raw materials to be purchased for the 1st month is R1. The DA = { DAi ; i Є 1 .. 10 } is the combination of the raw materials supplied by the supplier with their routing cost are separated and stored according to their length wise. Input : Best Chromosome BC, The raw materials supplied by the Suppliers SC, RC the routing cost of the raw materials supplied by the supplier DA, the combination database. Output : The Supplier list ΔS with minimum routing cost for the required raw material. Parameters: Mk ☾ MonthsPRk ☾ Purchasing raw materialPRcombi ☾ Combination list of purchasing raw material

Pseudo code:

For each Mk, ЄMGet PRkGenerate PRcombiSet l = length(PRk)Randomly select r < lFor each i≤rSel = r length data in PRcombiIf Sel exist in DArRCost = RCrEndifSS = min (Rcost)RR = DAr (min (Rcost))r= r-1End forΔS = ΔS + RREnd for

Pseudo code: 2 process of finding the best routing supplier.

The Pseudo code: 2 represents the steps used for finding the best routed supplier. From the best chromosome, the raw material list to be purchased for a month is identified and their each combination list is generated. The ‘ n’

combination list of supplier having the minimum routing cost is found out first and among ‘ n’ combination the combination having the minimum routing cost is selected for the first month. This process is repeated for every month and the supplier list with minimum routing cost for the required raw material is generated.

6. 6 Results

This section details the results and performance evaluation of the proposed approach. The proposed approach is implemented in the MATLAB platform (version 7. 10). The table 6. 4 represents the sample best chromosome having the optimized reorder point for ordering the raw materials. Table: 6. 4 Best chromosomeR1R2R3R4M11000M20001M31000M40001M51000M61000M71000M81010M91100M100101M110110M121101Table: 6. 5 Purchasing list of raw materialsMonthRaw materials to be purchasedM1R1M2R4M3R1M4R4M5R1M6R1M7R1M8R1, R3M9R1, R2M10R2, R4M11R3M12R1, R2, R4From the Table: 6. 4 the raw materials to be purchased are identified by their values and Table: 6. 5 represents the purchasing list of the raw materials to be purchased for the whole period. The raw materials which are supplied by the supplier are listed and their combination with the routing cost is stored in the database according to their length wise as shown in Table: 6. 6(a), Table : 6. 6 (b), Table: 6. 6 (c)Table 6. 6 (a)Suppliers list one combinationSupplierCombinationRouting Cost `1192013162314965219222211293192832112742113043163452113553163663164364100071939736457410 09Table 6. 6 (b)Suppliers list two combinationSupplierCombinationRouting Cost `11, 3228511, 4168913,

4233231, 2183431, 2185942, 3251252, 3252763, 4237571, 3235171, 4174473, 42384Table 6. 6 (c)Suppliers list three combinationSupplierCombinationRouting Cost `11, 3, 4297871, 3, 43060The table: 6. 6 represents the raw material list supplied by the suppliers which are arranged by their length. Purchasing list is searched in the ‘ 1’ length supplier list and their routing cost is found out and finally a best combination represents the supplier list to be chosen are found. The above steps are repeated ‘ n’ times to get ‘ n’ combination of the supplier list. From the ‘ n’ combination, the best combination having the minimum routing cost is selected for the first month. Likewise the best combination are chosen for the each month in the complete period. The best combination supplier list, corresponding routing cost and minimized total routing cost for the dataset-1, dataset -2, dataset-3, dataset-4 are illustrated in Table: 6. 7(a), Table6. 7 (b), Table6. 7(c) and Table6. 7(d). Table: 6. 7 (a) Best supplier combination list with the minimized routing cost Dataset -1. Resource => Supplier => CostMonth : 11 => 1 => 917Total Cost : 917Month : 24 => 1 => 967Total Cost : 967Month : 31 => 1 => 917Total Cost : 917Month : 44 => 1 => 967Total Cost : 967Month : 51 => 1 => 917Total Cost : 917Month : 61 => 1 => 917Total Cost : 917Month : 71 => 1 => 917Total Cost : 917Month : 81 3 => 1 => 2283. 3Total Cost : 2283. 3Month : 91 2 => 2 => 1845. 9Total Cost : 1845. 9Month : 102 => 2 => 11274 => 1 => 967Total Cost : 2094Month : 113 => 1 => 1620Total Cost : 1620Month : 121 2 => 2 => 1845. 94 => 1 => 967Total Cost : 2812. 9In the similar manner the other optimized chromosomes are generated for which, Table: 6. 7(b), Table: 6. 7(c) and Table: 6. 7(d) shows the best suppliers with minimum routing cost. Table: 6. 7(b) Best supplier combination list with the minimized routing cost

Dataset- 2. Resource => Supplier => CostMonth : 14 => 1 => 967Total Cost : 967Month : 24 => 1 => 967Total Cost : 967Month : 31 => 1 => 917Total Cost : 917Month : 44 => 1 => 967Total Cost : 967Month : 51 2 => 2 => 1845. 9Total Cost : 1845. 9Month : 61 => 1 => 917Total Cost : 917Month : 74 => 1 => 967Total Cost : 967Month : 83 4 => 1 => 2328. 3Total Cost : 2328. 3Month : 91 => 1 => 917Total Cost : 917Month : 101 2 => 2 => 1845. 94 => 1 => 967Total Cost : 2812. 9Month : 113 4 => 1 => 2328. 3Total Cost : 2328. 3Month : 121 3 4 => 1 => 2978. 4Total Cost : 2978. 4Table: 6. 7(c) Best supplier combination list with the minimized routing cost Dataset- 3. Resource => Supplier => CostMonth : 14 => 1 => 967Total Cost : 967Month : 24 => 1 => 967Total Cost : 967Month : 31 => 1 => 917Total Cost : 917Month : 44 => 1 => 967Total Cost : 967Month : 53 => 1 => 1620Total Cost : 1620Month : 64 => 1 => 967Total Cost : 967Resource => Supplier => CostResource => Supplier => CostMonth : 72 => 2 => 1127Total Cost : 1127Month : 81 4 => 1 => 1695. 6Total Cost : 1695. 6Month : 91 3 => 1 => 2283. 3Total Cost : 2283. 3Month : 102 => 2 => 1127Total Cost : 1127Month : 111 3 => 1 => 2283. 3Total Cost : 2283. 3Month : 124 => 1 => 967Total Cost : 967Table 6. 7(d) Best supplier combination list with the minimized routing cost Dataset-4Resource => Supplier => Cost Month : 11 => 1 => 917Total Cost : 917Month : 24 => 1 => 967Total Cost : 967Month : 31 => 1 => 917Total Cost : 917Month : 44 => 1 => 967Total Cost : 967Month : 52 => 2 => 1127Total Cost : 1127Month : 62 => 2 => 11273 4 => 1 => 2328. 3Total Cost : 3455. 3Month : 74 => 1 => 967Total Cost : 967Month : 81 2 => 2 => 1845. 94 => 1 => 967Total Cost : 2812. 9Month : 93 4 => 1 => 2328. 3Total Cost : 2328. 3Month : 103 => 1 => 1620Total Cost : 1620Month : 112 => 2 =>

11274 => 1 => 967Total Cost : 2094Month : 122 => 2 => 11274 => 1 => 967Total Cost : 2094

6. 7 Performance evaluation

The performance of the proposed approach is evaluated using different data sets. The performance is evaluated by comparing the total routing cost incurred from the recommended suppliers by the proposed method with the routing cost of the present method suppliers. The fig: 6. 1(a), fig: 6. 1(b), fig: 6. 1(c) and fig: 6. 1 (d) represents the Performance comparison graph of the routing cost of the recommend suppliers with the routing cost of the suppliers from present method for dataset-1, dataset-2, dataset-3 and dataset-4 respectively. Fig: 6. 1(a)Fig: 6. 1(b)Fig: 6. 1(c) Fig: 6. 1(d)The fig: 6. 1(a), fig: 6. 1(b), fig: 6. 1(c) and fig: 6. 1(d) illustrates that the routing cost of the suppliers recommend by the proposed method is less than the routing cost of the suppliers by present method.

6. 9 Conclusions

In this case study with the real existing data of INDIA CEMENTS LIMITED, the ordering quantity at proper reorder point has been found out and the total cost of the inventories is compared with the proposed system to the existing system. It is proved that the proposed system is more efficient than the existing system. Further the Facilities (capacity) of the existing system has been improved based on the ordering quantity and also with the aid of the proposed system the best routed supplier having minimum routing cost can be evaluated.