**BEST: International Journal of Management, Information Technology and Engineering (BEST: IJMITE)**
**ISSN(Print):2348-0513; ISSN(Online): 2454-471X**
**Vol. 3, Issue 8, Aug 2015, 9-18**


# FINDING NUMBER OF FURNACES THROUGH BREAK-EVEN ANALYSIS IN SMALL-SCALE MANUFACTURING UNIT

**BASANT KASHYAP[1] & SRIDHARK[2]**

[1]Research Scholar, Department of Mechanical Engineering, CSIT, Durg, Chhattisgarh, India

[2]Professor, Department of Mechanical Engineering, CSIT, Durg, Chhattisgarh, India

## ABSTRACT

In this paper the break-even analysis tool applied for product insulating sleeve in small-scale manufacturing units. In manufacturing operations time in furnace section taken highly time as compared to another sections. The break-even quantity (BEQ) and break- even point (BEP) are obtained when increasing the number of furnace. The calculations are shown in break-even chart. When applying three furnaces that are sufficient to reduced the operations time in furnace sections.

**KEYWORDS:** Break-Even Point, Break-Even Quantity, Manufacturing Operation Time

## INTRODUCTION

### Break-Even Analysis

The using Break- Even Analysis in order to find the break even quantities which are required to be produced in order to gain profit. The most significant indicators of achievement to start-up of small-scale manufacturing industry are the time from opening the firm till the running stage of plant.

- When revenues of product sales equals to the total costs related with the sale of product that is also called Break-Even Point (BEP). In other words that case the profit = 0.
- The break-even analysis is manipulative tool to assist the plan and manage the manufacturing operations.
- The Break-Even Point (BEP) signify the quantity of manufacturing firm, where company's whole revenues i.e. money coming into an initial stage of manufacturing industry are equivalent to its total operating cost (like total costs).
- In its simplest from, Break-Even Analysis give the insights into whether or not revenue from a product or service has the capacity to face the related costs of production of that product or service.

## LITERATURE REVIEW

Omoniyi, Benjamin Badeji **[2]** uses a grouping of descriptive analysis and simple mathematical formulae to calculate the profitability and the degree of operating leverage of the factory. The break-even analysis helps to examine how total costs and profits vary with output with respect to the degree of automation or mechanization of the installed plant of a factory such that the factory can withstand competition more effectively and give top level managers the chance to build comparisons. Archit Soni, Rituraj Chandraker, Vikas Kumar Sinha [1] introduced the wastes generating in the manufacturing process, and then they have analyzed the difficulty occurring with using Break-even analysis and the

suitable implication are given. Therefore their work is based on reducing the need of inventory in the plant and for that they have used more furnaces which can explain the problem of inventory up to a larger extent. Meysam Kaviani [4] adopting a quantitative approach and following a mathematical line of dispute conducts a fairly exhaustive financial analysis of leverages and break-even points (BEPs) and their implications for other financial indicators and growing on the assumed relationships between certain financial indicators and ratios on the one side, and different classes of leverages and BEPs on the other side, aimed to provide financial analysts with a more generic insight into the subject, allowing them in light of the presented concepts to further investigate the case from different angles.

Dr. Murari Premnath Sharma [5] introduced the formula and methodology for banking breakeven point. Which indicates that quantity of lending and deposit will recover the fixed cost and if there is desired profit it will also calculate. For breakeven point calculations we must fulfilled the above mentioned assumptions. This formula is useful we can compute breakeven interest as well as breakeven deposit amount and lending amount from above study. This study wills again refining in the latter study with decreasing number of assumptions.

Mohammed B. Ndaliman and Katsina C.Bala [6] introduced the objective is to establish the cost / revenue interactions on break-even charts. These charts were obtained for the five years studied. Among the practical realities exposed include: the sales revenue and total cost were not linear, two or more break-even points were found to exist, some costs fall under both fixed and variable costs, and further than certain optimum production levels, sales revenue decreases piercingly and total cost also increases. The sales revenue and total costs are not always linear in as in general assumed in the theory. Two or more break-even points may exist for a particular industry depending on a number of factors. Luis Javier Serrano Tamayo [7] explained the individuality of the research lies in the use of an engineering computational tool combined with a statistical analysis of the vessels navigation, in order to quantify the variable costs. With this objective criterion was done a breakeven analysis and evaluated the investment decision. The new model of variable costs calculation, combining the naval computational tool with the statistical analysis of vessel's fuel consumption was useful and reliable for break-even analysis.

Nagendra Sohani, Burhan Adil [8] introduced the Small Scale Manufacturing Organizations should be very conscious, while selecting product before initial manufacturing. Because without implementation of atomization it is very difficult to get break even small scale industries are facing same problem. A break even analysis shows the comparative between the cost and profit with sale volume. The sales volume which equates total revenue with linked cost and result in neither profit nor loss is called break even volume. Erkki K. Laitinen [9] analyzed the relationship between the sales volume and the profit of the firm. In this paper BEA is extensive and applied for payment default prediction. First, breakeven point is defined the point, result may mean that the assumptions of BEA and its extended version are too simplify for larger firms. The structure of these firms is difficult and the sales and cost curves may be curvilinear instead of being linear. Robert Edwards and Royce Jones [10] proposes and demonstrates the computation of a monthly break-even point, expressed in sales dollars, which can serve as a control standard for determining whether a profit was made in a particular month. The monthly break-even point also provides an estimate of the level of the profit (or loss). Estimate of the break-even point is simple, uses data readily available to small business operators, The use of cash flow data to calculate profitability will never be perfectly precise because the costs of some products will occur in different periods than the receipt of their sales revenues and some fixed costs are not paid at even intervals. the calculation and use of monthly break-even points can be a valuable control device for small business operators, provide they recognize it for what it is just

another indicator of their business' performance in the short run and do not attempt to substitute it for traditional financial statements and analyses.

Clem Tisdel [11] examined the firm's total revenue will be a non-linear function of the amount of the product supplied by the firm to the market. Even so, since fixed price behaviour by businesses may be common, as well as constant average variable costs of production over a considerable range of output, linear break-even analyses has a considerable range of application to business. Under conditions of imperfect competition, linear break-even analysis may be quite related in the kinked demand oligopolistic case and in circumstances where the business engages in fixed pricing, possibly for behavioural reasons.

Enyi Patrick Enyi [12] helped in perfecting the existing mathematical model for finding the breakeven point of a firm and for analyzing the implications of a firm's activity level on its costs and profits, has seriously reduced and hindered considerably the use of the concept in analyzing the economic implications of volume in a multi-product business organization of today's competitive business environment. The implication of this development is that the assumption of 'only one product line' no longer hold in breakeven analysis and hence, recommended for pedagogical purposes.

**Problem Identification**

For the analysis product insulating sleeve selected, the major product of the industry for analysis in our project as it earns maximum profit to the firm as compared to other products. Now we have done all our analysis for the product insulating sleeve only. The data that are related to break-even analysis are collected from the manufacturing firm like how much times is required in the complete process of production, what quantity of materials are required , at what cost the product can be manufactured ,and what is the selling price of the product

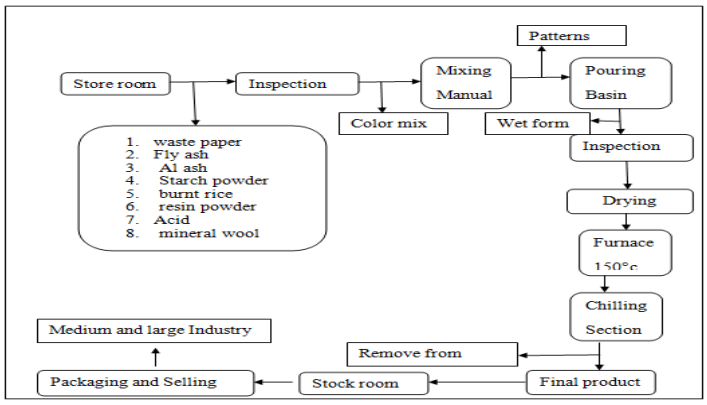


**Figure 1: Flow Diagram of Product Insulating Sleeve**

The above figure 1 shows the systematic flow of part or piece of that product in a proper manner. The process are started from the store room or stock room and finished at packaging and selling process to other medium and large scale industry. At the initial stage the different types of raw materials are mixing to each other. When going on furnace section the maximum time taken the furnace operations so that for eliminating this time break-even analysis are conducted to minimize the furnace time operations. When analyzing the various manufacturing process the different types of variations and barriers are identified in the production process.

**Data Collection**

The following data which is shown in below table

**Table 1:Time Required to Perform the Operations**

| Manufacturing Operations | No. of Items Produced | Time Taken | Precious Time |
|---|---|---|---|
| The appropriate composition is made | 50 | 15 minute | 15 minute |
| Mixing the raw materials | 50 | 80 minute | 80 minute |
| Pattern is dipped in proper mix up | 50 | 5 minute | 4 hours 10 minute |
| Operation of surface finishing | 50 | 3 minute | 2 hours 30minute |
| Process of natural drying | 50 | 2 hour | 2 hours |
| Process of heat treatment | 15 | 8 hour | 16 hour |
| Process of natural cooling | 15 | 2 hour | 2 hour |
| Packaging the finished goods | 15 | 5 minute | 1 hour 15 minute |

The on top of table 1 can be obviously shown that there are the appropriate composition is made to natural drying operation the 50 products which are manufactured in the process in proper manner. This heat treatment operational process required maximum number of time because using only single furnace so that use more than one furnace and checked the BEP for different numbers of furnaces. Then find the number of furnaces which is most appropriate for this manufacturing firm

## METHODOLOGY

Calculation of Break-Even Point (BEP)

The price that the manufacturing industry is charge, variables costs (direct costs) of each unit and fixed costs (or indirect costs / overheads cost).

**Terminology Symbols**

- Total Revenue TR
- Selling Price P
- Number of Units Sold Q
- Total Costs TC
- Fixed Cost F
- Variables Costs V
- Total Fixed Cost FC
- Total Variable Costs VC

**Formulation of the Terms**

$TR = P \times Q$

$VC = C \times Q$

$TC = FC + VC$

Profit = TR – TC

Because there is no profit (€0):

TR –TC = 0

P×Q – (F+V×Q) = 0

$Q = \frac{F}{P-V}$

When use only one furnace:

Fixed Cost: F = 20000

Manufacturing Cost: V = Rs 300/ unit product

Number of product produced: 15 per day

Selling price: P = Rs 400 per unit of product

$Q = \frac{F}{P-V}$

$BEQ = \frac{20000}{400-300}$

BEQ = 200

When observing the process in order to rise above. The investment had done the production require to be continued for 19 days and after that earn profit. But there are 35 quantities not here from heat treatment.

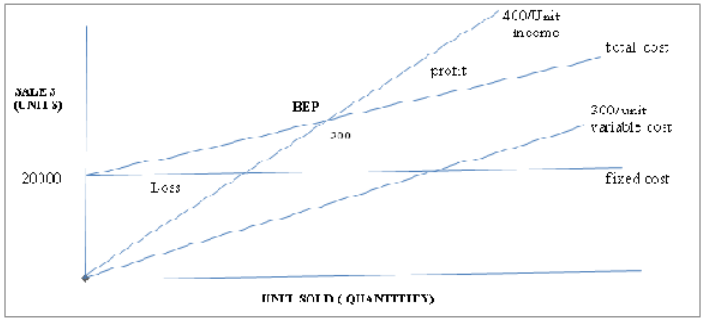


**Figure 2: Break- Even Chart When Using one Furnace**

The above figure 2 shows result of applying 1st furnace and provide the relationships between sales of product and quantity which are sold. It gives at the initial stages to easily understanding of profits and losses of manufacturing firm. It also provides the BEP, variable cost and fixed cost.

So that goes for two furnaces:

Using two Furnaces:

Incurred Cost:

Fixed Cost: F = Rs 35000

Manufacturing Cost: V = Rs 300 per unit of product Break –Even Chart

Number of Products Produced: 30 per day

Selling Price: P = Rs 400 per unit of product

$Q = \frac{F}{(P-V)}$

$BEQ = \frac{35000}{(400-300)}$

BEQ = 350

When observing the process in order to rise above the investments had done the production require to be continuous for 12 days and after that gain profit. But there are 20 products not here from heat treatment operation in manufacturing firm

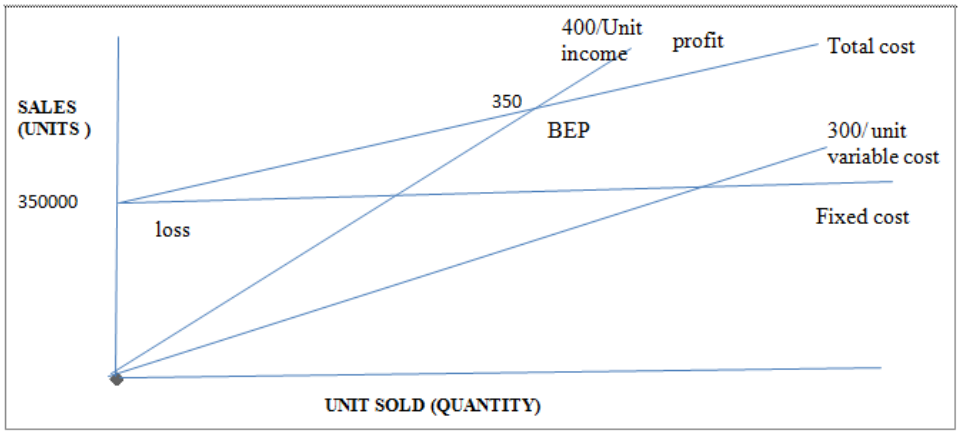


**Figure 3: Break- Even Chart While Using Two Furnaces**

The figure 3: shows the results of after applying the two furnaces. In these steps the BEP quantity is increases and Break-Even Quantity (BEQ) is also increases.

So that goes for three Furnaces.

When using three Furnaces

Incurred Cost:

Fixed Cost (F): Rs 5000

$BEQ = \frac{50000}{(400-300)}$

Manufacturing Cost: V = Rs 300 per unit of product

Number of Products Produced: 45 per day

Selling Price: P = Rs 400 per unit of product

$Q = \frac{F}{(P-V)}$

BEQ = 500

When observe the process in order to rise above the investment has done the production require to be continued for 11 days and after that gain profit. But there are 5 quantities of product not here from heat treatment operation

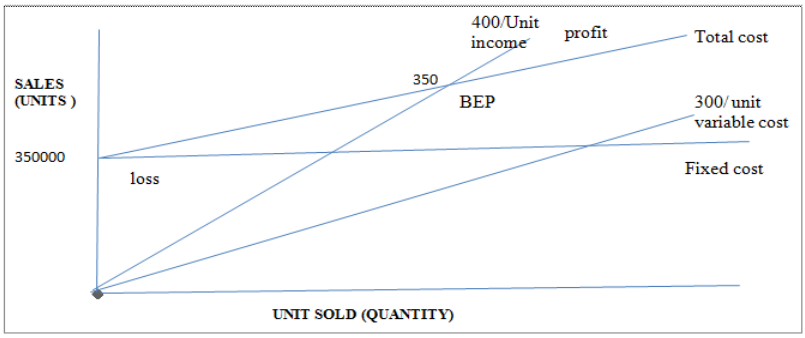


**Figure 4: Break Even Chart While Using Three Furnaces**

The above figure 4 shows the result when applying three furnace. In this figure also increase the quantity of BEQ and BEP.

So go for four furnaces.

When using four Furnaces

Incurred Cost:

Fixed Cost: F = Rs 65000

Manufacturing Cost: V = Rs 300 per unit product

Number of Product Produced: 50 per day (According to the production is limited to 50)

Selling Price: P = Rs 400 per unit product

$$Q = \frac{F}{(P-V)}$$

$$BEQ = \frac{65000}{(400-300)}$$

BEQ = 650

When observing the process in order to rise above the investment has done the production require to be continued for 13 days and after that gain more profit. But when going on four furnaces, noticed that the four furnaces remains non-working for the most part of the times.

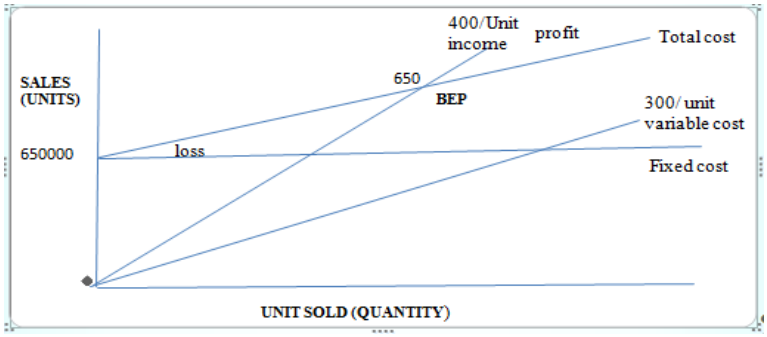


**Figure 5: Break Even Chart While Using Four Furnaces**

The above figure 5 shows the result of when applying 4th furnace. These are the maximum limits of produce product in 50 per day. That cannot applying the 4th because the limit are maximum.

**Result**

When analyzing the furnace required for product insulating sleeve the Break-Even Analysis are conducted successfully and we have found the importane results which are shown in the table below

**Table 2: Observations from Break Even Analysis**

| No .of Furnaces required | No. of Products Produced/per Day | Profit in Rs |
|---|---|---|
| 1st | 15 | 1500 |
| 2nd | 30 | 3000 |
| 3rd | 45 | 4500 |
| 4th | 50 | 5000 |

In the above table 2 shows the results of observations made from the break-even analysis, so that can say the profits are increased by increasing the number of furnaces required in product insulating sleeve and hot top in the manufacturing firm selected. The productions can gains maximum profits by employing 3rd number of furnace in the selected manufacturing firm. When use 4th number of furnace in the manufacturing firm then found that the profit is not so more as compared to 3rd number of furnace and at the most of the times in a day remain empty the 4th number of furnace. So that can suggest using 3rd number furnace in the most appreciate manufacturing firm in order to maximize the profits and production itself.

## CONCLUSIONS

Finally in case of product insulating sleeve the maximum time taken by using the single furnace. When observing through the Break-Even Analysis the three furnaces are more suitable for maximizing the profit in the manufacturing firm.

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