CHAPTER NO. IV
COST OF PRODUCTION OF SUGAR FACTORY

4.1 Introduction:

The sugar industry is becoming competitive day-by-day as the demand for sugar consumption is increasing. In present sugar Factory scenario, the study of cooperative sugar factories in Kolhapur District is vital study. Our main criteria is to focus on variable cost which is controllable. Therefore, total cost is segregated into cash conversion cost and fixed cost to arrive at total cost of production.

This chapter gives the basic concepts of cost of production, maintenance for productivity in sugar plants, factors affecting the cost of production of sugar, information about co-products, Techniques for productivity improvement, cost reductions etc.

4.2 Cost of Production

Cost of production of sugar is the sum total of all expenses incurred in the production of sugar. For eg. Cane Price, H & T Exp, purchase Tax, etc. and second part of production is cash conversion cost. In conversion cost incurred power exp, chemicals and consumables, salary & wages, packing, repairs and maintenance, overheads, Depreciation and Interest etc.

4.3 Factors Affecting the cost of production of sugar

1) Recovery :- Which is the ratio of sugar produced to the cane crushed.

The quality and maturity of cane crushed will determine the recovery. The cost of sugar produced by two factories with identical capacity will be different if the recovery is different. Recovery varies from unit to unit and within the same unit from year to year. While the minimum cane price fixed by the Govt. from unit to unit and within the same unit from year to year. While the minimum cane price fixed by the Govt. from time to time is based on a uniform recovery of 8.5% the actual price paid is adjusted pro-rata to the variation in the recovery percentage.

Recovery depends again on the agricultural practices followed in the area

2) Duration :- Which is the number of crushing days of say 22 hours per day. The availability of cane within a reasonable distance from the sugar factory and the competitive demand in the area determines the duration. It is also dependent on the ability of the sugar factories to attract cane at a price in preference to the competitive users of sugarcane like gur and Khandsari manufactures. The cost of sugar produced...
in two factories with identical capacity will be different if the duration of crushing in a season varies. Higher the duration, higher will be the production of sugar which will result in lower cost due to distribution of fixed cost over a larger volume of production.

3) **Capacity of production** :- The installed capacity of the sugar plant and the actual utilization of the installed capacity have a bearing on the cost of production of sugar. The higher the installed capacity, the capital cost per tonne of sugar production is likely to be lower. The better the capacity utilization, the lower the fixed cost per tonne of sugar produced.

4) **Age of the Plant** :- The age of the plant determines its efficiency in operation. It has also its impact on depreciation and return on capital employed. While older plants will have lower depreciation and capital employed, it will also have lesser efficiency in operation. New plant will have a higher impact on depreciation and capital employed and at the same time its operational efficiency will be much better.

5) **Process employed in the production of sugar** :- While carbonization plant will have higher cost of production, sulphitation plants will have comparatively lower cost of production. At the same time the extra cost of carbonization is generally offset by the higher realization from the sale of sugar of superior grade.

4.4 **Maintenance For Productivity In Sugar Plants** :-

The sugar industry in an agro based seasonal industry and interruption due to bad mechanical working during season not only results in low capacity utilization but the raw material being perishable also deteriorates rapidly. The time loss during the season may mean production loss. Therefore in a sugar factory plant maintenance assumes much significant importance as lack of planning and lackadaisical attitude of maintenance staff in their respective area leads to higher maintenance cost, excessive storage stores of spares and engineering stores, high overtime besides production loss.

The management has become cost conscious in the days of limited profitability due to increase in the price of raw material, high cost of other material, production loss etc the utility of latest development in the field of maintenance is receiving attention. Thus an aim is to keep the downtime minimum amongst others things while running the plant. In many sugar plants proper maintenance system does not exist and people are still in the habit of attending the machines only when there is a break down. Barring a few mills there is a tendency, in general not to stop the machinery for regular maintenance and making small investment over that with, the
result machinery is run to death. This tendency is anti productive and concept is totally wrong. So there should be change in entire outlook. Other hand in similar condition a better maintained plant gives better capacity utilization without increasing extra expenditure and losses are reduced to optimum level. It is there fore all the more necessary to take suitable actions including evolving a good maintenance system so that downtime remains within reasonable limits.

1) **Present Status of Maintenance**

   - There is no predictive/preventive maintenance system.
   - There are no records of individual equipment about make, cost, supplier's name and detailed specification.
   - There is no system of keeping descriptive records, cost records about the repair done on different item of Machinery
   - There is no proper training programme for skilled labors / supervisory staff.
   - There is no proper house keeping works.
   - There is no regular plant safety and productivity committee.
   - A separate inspection cell does not exist.

2) **Factors need to be Considered :-**

   1) Sugar factory is a seasonal and continuous process factory. Season period is limited. Any shortfall in capacity utilization due to interrupted working will adversely effect the profitability of the unit.
   2) There is no separate full - fledged maintenance department. There are two categories of workers. One Coming in shifts and the other comes in general shift who are responsible for maintenance in the crushing season.
   3) Heavy corrosion of metal takes place if proper PH is not maintained and cause reduction in the life of plant and machinery. Sometimes excessive corrosion increases the downtime ultimately resulting in loss of production.
   4) The existing staff and labour are not imparted adequate training with the result they have not developed capability and ability to adopt modern engineering functions.

3) **The Raw Cane Sugar Factory :-**

   The flow sheet of a typical raw sugar factory is given in Fig 4.1. to show the interdependence and relative importance of the various departments of the factory and of their products.

   Apart from sugar the factory produces the following by products.
- Bagasse (Surplus)
- Molasses
- Filtermud
- Furnace ash
- Electricity (Surplus)

On the average for every 100 metric tonnes of cane ground the factory will produce.

11.2 tonnes Raw Sugar (95.5 pol)
5.0 tonnes Surplus bagasse (at 49 % moisture)
2.7 tonnes Molasses (89 Brix, sp.gr. 1.47)
3.0 tonnes Filter mud (at 80 % moisture)
0.3 tonnes Furnace ash
1300 KWH Surplus Electricity

These figures are only indicative and are based on a number of assumption such as; sucrose % cane, 13.0 fibre % cane, 13.0; Mill extraction, 95 %; overall recovery, 85 %, purity of mixed juice, 84.0 %; steam consumption, 500 kg per tonne of cane, 2.3 tonnes of steam generated per tonne of wet bagasse.¹

Returning to the main by-products, it is useful, in order to clarify our ideas, to make a rough estimate of their value to the sugar producer. Flow diagram of a raw sugar industry is as follow.
The Raw Cane Sugar Factory

Fig. No. 4.1: Flow diagram of raw sugar factory.
By- Products

Fig. No. 4.2 By Products of the cane sugar industry.
From Fig No. 4.2 indicates that the by products of cane sugar which have found an industrial utilization, and the two main raw materials are bagasse and molasses.

### 4.5 Sugarcane Co-Products:

In the year 2010 the International society of sugar cane Technologists (ISSCT) have renamed the by-products of the cane sugar industry as Coproducts, due to the reason that these so called by-products are equally important as the end product (sugar) itself and hence, they can be termed as Co-product's.²

Sugarcane as a 'Wonder Crop' due to the reason that many value added products can be manufactured from sugarcane and its Co-Products. Sugarcane is also considered as an 'Energy Crop' as it is a source of many forms of energy; That is why, many cane sugar producing countries particularly those located in the Latin - American and Caribbean Countries have adopted Integral utilization of sugarcane and its Co-Products. The Co-products of sugarcane are as follows.

#### A. Field Co-Products -

1) **Green leaves of sugarcane** -

Normally green leaves of sugarcane are used as cattle feed. But as cattle relish green colour of the leaves, which is present only during the cane harvesting period. In some countries (Mauritius) the green colour of the leaves is preserved by heaping up the green leaves, drenching them with a solution of molasses and urea and covering the heaps with tarpaulins. In some other countries (China, Taiwan) the green leaves are chopped into bits and mixed with other ingredients of cattle feeds like grain, Oil cakes yeasts etc. and packed into polythene bags to be used as cattle feed round the year.

2) **Dried leaves of sugarcane (Trash)** -

Dried leaves of sugar cane (Trash) were earlier used for mulching in order to prevent the evaporation of water from the fields. It was also burnt in the fields in order to avoid any fire hazard. It is also believed that by this practice of burning, pests and diseases are eradicated and the ash so formed add small quantities of fertilizers to the field.

But in the recent years the scientists have realized that the fuel value (Calorific Value) of trash is equal to that of mill wet bagasse (4180 Kcal/kg or 7540 Btu/Lb) and hence, one tonne of trash can generate as much steam as one tonne of mill wet bagasse can generate (about 2.5 tonnes of steam) Due to this realization of the fuel value of trash, mobile baling equipment has been developed in Belgium, France and
Germany known as Hay Balers. These are quite suitable for baling trash in the fields, reducing its bulk density and also helps to reduce the incidence of transport charges and bring the bales of trash to the sugar mills for using it as fuel in the boilers. Two firms in India also have started fabricating Trash balers and many sugar mills are using them advantageously. Trash has proved as a very promising fuel for the off season to continue generation of steam and thereby co-generation round the year. Thus in the recent years the pattern of utilization of trash has changed and its fuel value is being exploited fully.

3) Factory Co-Products :-

a) Bagasse

Now a days the sugar mills are not prepared to sell their surpuls bagasse to the paper mills. They are selling surplus bagasse to neighbouring sugar mills, which have cogeneration projects, as they pay more for surplus bagasse, which they can advantageously use as fuel in the boilers.

In the recent years many sugar mills have introduced energy conservation measures by which they have reduced the consumption of steam and there by reduced the consumption of bagasse as fuel. The sugar mills have installed high pressure boilers (1500 Psing and 950° F temperature) and multi stage steam turbines coupled to power generators to generate electric power efficiently with less steam and thereby saving lot of bagasse for using it during the off season to generate steam and keep the cogeneration going on round the year.

b) Molasses :-

Every one connected with the sugar industry is well aware that though molasses can be used for the manufacture of many chemicals, molasses is best used for the manufacture of ethyl alcohol by fermentation and distillation. This is an old age practice.

In the recent years, as ethyl alcohol is being used as fuel in the automobiles, More efficient methods have been developed to manufacture ethyl alcohol from molasses. Some of these efficient methods are 1) Continuous fermentation of molasses. 2) Use of improved strains of micro organisms to bring about quick fermentation of molasses with high yields of alcohol. 3) Adoption of pressure distillation to reduce the consumption of steam for distillation 4) Molecular sieve technology to dehydrate rectified sprit efficiently for using the anhydrous alcohol to admix with petrol and use it as automobile fuel. All these improved technologies have
resulted in more efficient methods for producing ethyl alcohol from molasses in short duration.

c) Distillery Effluents :-

In the earlier years distillery effluents were simply let out into the nearby canals, rivers etc. to be used as irrigation water for the sugarcane crop. This was leading to pollution problems.

Now a days, same distilleries are mixing the distillery effluents with press mud and using it as compost having more NPK to be used as fertilizer in the sugarcane fields.

In many distilleries, the effluents are used in the bio digesters for generation of biogas (60 % carbon dioxide and 40 % Methane gas) and this gas is used as fuel in the boilers. By adopting methods to enrich the methane content of the biogas, the gas can be used as fuel in internal combustion engines, as is being practiced in Brazil. Two such plants are also being set up in India.

d) Press Mud :-

In the earlier years, press mud was being used as manure in the sugarcane fields. In the recent years, a few sugar mills in the state of Tamil Nadu are generating biogas from press mud and using it as domestic fuel and in the laboratories. It is advantageous for other sugar mills also to adopt this practice.

e) Chimney Gases :-

The chimney gases generated by burning bagasse as fuel in the sugar mill boilers contain about 12 to 14 % carbon dioxide. Emission of carbon dioxide gas, otherwise known as ‘Green House Gas’ into the atmosphere is injurious to the environment. In countries like Pakistan, South Africa, Japan, Chimney gases are being scrubbed with water to remove the suspended particles and the resultant gas is bubbled through cane juice to clarify the limed juice. Thus installation of lime kilns to generate carbon dioxide gas is avoided. Use of chimney gases as clarification agent results in arresting environmental pollution also with chimney gases.

f) Sugar Factory Effluents :-

Though sugar mill effluents have been in use all these years as irrigation water in the sugarcane fields, in a few sugar mills, Sugar mill effluents are mixed with distillery and used for generation of biogas, to be used as boiler fuel.
Adoption of improved scientific practices in the recent years have changed the pattern of utilization of the Co - Products of cane sugar industry in an advantageous manner, and reduction of cost of conversion.

Production of sugar in India shows large cyclical fluctuations. This creates unhealthy imbalance which not only affects economy of the sugar industry directly but availability of by - products like bagasse and molasses touches extreme low and high levels. For healthy growth of the by product, utilising industries stability of the sugar industry is very important. ²

4.6 Cost of Production :-

Due to the cyclic nature of the sugar industry, the area under sugarcane cultivation sugarcane production as well as sugar production has been drastically reduced during the year 2008 - 09 in India in comparison to immediate previous years. The following table indicates the cyclic nature.

<table>
<thead>
<tr>
<th>Year</th>
<th>Area under sugarcane (Lac hr)</th>
<th>Production of Sugarcane (Lac Tonnes)</th>
<th>No. of factories in operation</th>
<th>Average (days)</th>
<th>Total Cane crushed (Lac tonnes)</th>
<th>Total sugar production (Lac tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006-07</td>
<td>51.51</td>
<td>3555.20</td>
<td>504</td>
<td>173</td>
<td>2792.95</td>
<td>283.67</td>
</tr>
<tr>
<td>2007-08</td>
<td>50.55</td>
<td>3481.88</td>
<td>516</td>
<td>149</td>
<td>2499.06</td>
<td>263.57</td>
</tr>
<tr>
<td>2008-09</td>
<td>44.15</td>
<td>2850.29</td>
<td>488</td>
<td>87</td>
<td>1449.78</td>
<td>145.38</td>
</tr>
</tbody>
</table>

Source - Financial Performance of Co - Op sugar factories in Maharashtra VSI Pune Year 2008 - 09

The country's sugar production is decreased by 118.19 Lac tonnes against previous season whereas the consumption of sugar is increased 220.00 lack tonnes to 230.00 lac tonnes. Therefore, there is a mismatch of production and consumption of sugar, which results in increase of sugar price. The sugar industry is becoming competitive day by day as the demand for sugar consumption is increasing. Therefore, Promoting cost consciousness to be competitive is a need of the hour and this study will focus some light for future action for those are concerned in this industry.

During the crushing season 2008 - 09, 146 sugar factories were in operation including 28 private sugar factories in Maharashtra.
Total cost is segregated into cash conversion cost and fixed cost to arrive at total cost of production. The cash conversion cost includes the elements of cost like power, chemicals and consumables, salary and wages, packing Materials, repairs and maintenance and overheads. The fixed cost includes interest and depreciation.

4.7 Cost Analysis Of State

The element wise cost of production of sugar per quintal are analyzed for the financial year 2008-09 and salient features are given as under.

1) Cane Cost -

The cane cost includes cane price, Harvesting and Transportation (H&T) expenses and cane purchase Tax (PT)

i) Cane Price -

The average cane price per tonne of cane paid during last seven years is given as under.

Table No. : 4.2
Cane Price.

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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Avg.Cane Price (Rs. Per tonne)</td>
<td>879.19</td>
<td>1310.71</td>
<td>1406.29</td>
<td>939.16</td>
<td>934.17</td>
<td>1580.46</td>
<td>2359.34</td>
</tr>
<tr>
<td>% to total Cost of production</td>
<td>49.46</td>
<td>61.56</td>
<td>63.64</td>
<td>56.93</td>
<td>55.69</td>
<td>64.55</td>
<td>70.53</td>
</tr>
</tbody>
</table>

Source - Financial performances of VSI, year 2003 - 04 to 2009 - 10

Table No. 4.2 Indicates that, due to lower selling price of sugar during the year 2006-07, average cane price is decreased. During 2008 - 09 and 2009-10, the cane price as well as the percentage to total cost of production is highest among last five years.

ii) H&T Expenses :-

Table No. : 4.3
Harvesting and Transports

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<tr>
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</thead>
<tbody>
<tr>
<td>Avg.H&amp;T cost (Rs. Per tonne)</td>
<td>203.66</td>
<td>187.34</td>
<td>248.25</td>
<td>240.71</td>
<td>238.14</td>
<td>248.77</td>
<td>302.84</td>
</tr>
<tr>
<td>% to total Cost of production</td>
<td>11.46</td>
<td>8.80</td>
<td>11.23</td>
<td>14.59</td>
<td>14.20</td>
<td>10.16</td>
<td>9.05</td>
</tr>
</tbody>
</table>

Source - Financial performance of VSI, year 2003 - 04 to 2009 - 10
Table No. 4.3 indicates that, the average H&T cost is in the range of Rs. 238.14 to Rs. 248.77 during last five years, Though it was below Rs. 190.00 during 2004 - 05

iii) Cane Purchase Tax :-

Table No. : 4.4

Cane purchase Tax

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</thead>
<tbody>
<tr>
<td>Avg. Purchase tax (Rs. Pertonne)</td>
<td>N.A.</td>
<td>45.54</td>
<td>45.03</td>
<td>5.84</td>
<td>23.70</td>
<td>45.26</td>
<td>69.52</td>
</tr>
<tr>
<td>% to total Cost of production</td>
<td>0.00</td>
<td>2.14</td>
<td>2.04</td>
<td>0.35</td>
<td>1.41</td>
<td>1.85</td>
<td>2.08</td>
</tr>
</tbody>
</table>

Source :- Financial Performance of V.S.I year 2003 - 04 to 2009 - 10

Table No. 4.4 Indicates that the purchase tax was waived during 2006 - 07 season and it was reintroduced in 2007 - 08

iv) Cane cost

Table No. : 4.5

Cane Cost

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<tr>
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</thead>
<tbody>
<tr>
<td>Avg.Cane Cost (Rs. Pertonne)</td>
<td>1082.85</td>
<td>1603.59</td>
<td>1699.57</td>
<td>1185.71</td>
<td>1196.00</td>
<td>1874.50</td>
<td>2731.70</td>
</tr>
<tr>
<td>% to total Cost of production</td>
<td>60.91</td>
<td>72.50</td>
<td>76.91</td>
<td>71.88</td>
<td>71.31</td>
<td>76.59</td>
<td>81.66</td>
</tr>
</tbody>
</table>

Source - Financial Performances of VSI year 2003 - 04 to 2009-10

Table No. 4.5 : Indicates that the average cane cost during 2008 - 09 is the highest among last five years. The average cane cost includes cane price, H&T and cane purchase cost.

2. Cash Conversion Cost -

The average cash conversion cost per quintal of sugar for last seven years is given below.
Table No. 4.6
Cash conversion cost.

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<tr>
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</thead>
<tbody>
<tr>
<td>Avg. Cash conversion (Rs. QTL)</td>
<td>310.31</td>
<td>299.80</td>
<td>273.88</td>
<td>264.99</td>
<td>258.66</td>
<td>339.69</td>
<td>371.64</td>
</tr>
<tr>
<td>% to total Cost of production</td>
<td>19.84</td>
<td>17.15</td>
<td>14.97</td>
<td>18.70</td>
<td>18.44</td>
<td>16.31</td>
<td>12.98</td>
</tr>
</tbody>
</table>

Source - Financial Performance of VSI, year 2003-04 to 2009-10

Table No. 4.6 Indicates that the average cash conversion cost per quintal of sugar of the Maharashtra State during 2008-09 comes to Rs. 339.69, Which is increased by Rs. 81.03 as compared to previous year. This increase is due to increase in all elements of cash conversion cost compared to last year.

3. Conversion Cost -

Conversion cost includes Depreciation and Interest. The average conversion cost per quintal for last seven years is as follows.

Table No. 4.7
Conversion Cost

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<tr>
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</thead>
<tbody>
<tr>
<td>Avg. Conversion cost (Rs./Qtl)</td>
<td>611.99</td>
<td>480.90</td>
<td>422.35</td>
<td>398.37</td>
<td>402.44</td>
<td>488.33</td>
<td>524.73</td>
</tr>
<tr>
<td>% to total Cost of production</td>
<td>39.09</td>
<td>27.51</td>
<td>23.09</td>
<td>28.12</td>
<td>28.69</td>
<td>23.44</td>
<td>18.33</td>
</tr>
</tbody>
</table>

Source - Financial performance of VSI, year 2003-04 to 2009-10

Table No. 4.7 : Indicates that, there is an increase in average conversion cost per quintal during 2008-09 of Rs. 85.89 as compared to previous year. Though amount-wise increase per quintal is more, percentage-wise it is less as compared to last year mainly due to higher cane price.
Table No. : 4.8

Comparative statement of element-wise average cost per quintal of sugar of sugar factories in Maharashtra.

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<tbody>
<tr>
<td></td>
<td>Above 90% Cap. Uti z.,(Rs.)</td>
<td>% to total Cop</td>
<td>Above 90% Cap. Uti z.,(Rs.)</td>
<td>% to total Cop</td>
<td>Above 90% Cap. Uti z.,(Rs.)</td>
<td>% to total Cop</td>
<td>Above 90% Cap. Uti z.,(Rs.)</td>
<td>% to total Cop</td>
</tr>
<tr>
<td>1) CANE COST</td>
<td>Cane Price</td>
<td>774.40</td>
<td>49.46</td>
<td>1076.30</td>
<td>61.57</td>
<td>1164.29</td>
<td>63.64</td>
<td>806.66</td>
</tr>
<tr>
<td></td>
<td>H &amp; T Exp</td>
<td>179.39</td>
<td>11.46</td>
<td>153.84</td>
<td>8.80</td>
<td>205.53</td>
<td>11.23</td>
<td>206.75</td>
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<tr>
<td></td>
<td>Purchase Tax</td>
<td>0.00</td>
<td>0.00</td>
<td>36.93</td>
<td>2.11</td>
<td>37.28</td>
<td>2.04</td>
<td>4.97</td>
</tr>
<tr>
<td></td>
<td>Total cane cost</td>
<td>953.79</td>
<td>60.91</td>
<td>1267.07</td>
<td>72.49</td>
<td>1407.10</td>
<td>76.91</td>
<td>1018.38</td>
</tr>
<tr>
<td>2) CASH CONVERSION COST</td>
<td>Power</td>
<td>9.40</td>
<td>0.60</td>
<td>8.98</td>
<td>0.51</td>
<td>5.63</td>
<td>0.31</td>
<td>5.87</td>
</tr>
<tr>
<td></td>
<td>Chemicals consumables</td>
<td>14.68</td>
<td>0.94</td>
<td>13.77</td>
<td>0.79</td>
<td>14.14</td>
<td>0.77</td>
<td>15.36</td>
</tr>
<tr>
<td></td>
<td>Salary &amp; wages</td>
<td>34.18</td>
<td>2.18</td>
<td>127.51</td>
<td>7.29</td>
<td>102.65</td>
<td>5.61</td>
<td>95.76</td>
</tr>
<tr>
<td></td>
<td>Packing</td>
<td>114.13</td>
<td>7.29</td>
<td>38.64</td>
<td>2.21</td>
<td>40.74</td>
<td>2.23</td>
<td>40.51</td>
</tr>
<tr>
<td></td>
<td>Repairs &amp; Maintenance</td>
<td>51.77</td>
<td>3.31</td>
<td>30.35</td>
<td>1.74</td>
<td>44.02</td>
<td>2.41</td>
<td>48.45</td>
</tr>
<tr>
<td></td>
<td>Overheads</td>
<td>86.55</td>
<td>5.53</td>
<td>80.55</td>
<td>4.61</td>
<td>66.70</td>
<td>3.65</td>
<td>59.04</td>
</tr>
<tr>
<td></td>
<td>Total Cash Conversion Cost</td>
<td>310.71</td>
<td>19.84</td>
<td>299.80</td>
<td>17.15</td>
<td>273.88</td>
<td>14.97</td>
<td>264.99</td>
</tr>
<tr>
<td>3) Depreciation</td>
<td>53.71</td>
<td>3.43</td>
<td>42.93</td>
<td>2.46</td>
<td>49.56</td>
<td>2.71</td>
<td>33.85</td>
<td>2.39</td>
</tr>
<tr>
<td>4) INTEREST</td>
<td>Working Capital</td>
<td>139.29</td>
<td>8.90</td>
<td>72.08</td>
<td>4.12</td>
<td>50.32</td>
<td>2.75</td>
<td>55.33</td>
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<tr>
<td></td>
<td>Term Loan</td>
<td>71.37</td>
<td>4.56</td>
<td>40.00</td>
<td>2.29</td>
<td>24.11</td>
<td>1.32</td>
<td>27.33</td>
</tr>
<tr>
<td></td>
<td>Deposits</td>
<td>36.91</td>
<td>2.36</td>
<td>26.09</td>
<td>1.49</td>
<td>24.48</td>
<td>1.34</td>
<td>16.87</td>
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<tr>
<td></td>
<td>Total Interest</td>
<td>247.57</td>
<td>15.81</td>
<td>138.17</td>
<td>7.90</td>
<td>98.91</td>
<td>5.41</td>
<td>99.53</td>
</tr>
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<td>--------</td>
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<td>% to</td>
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<tr>
<td></td>
<td></td>
<td>total</td>
<td>total</td>
<td>total</td>
<td>total</td>
<td>total</td>
<td>total</td>
<td>total</td>
</tr>
<tr>
<td></td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td>Above 90% Cap. Uti z.(Rs.)</td>
<td></td>
</tr>
<tr>
<td>5)</td>
<td>Conversion Cost (2+3+4)</td>
<td>611.99</td>
<td>39.09</td>
<td>480.90</td>
<td>27.51</td>
<td>422.35</td>
<td>23.09</td>
<td>398.37</td>
</tr>
<tr>
<td>6)</td>
<td>Total Cost of Production (1+5)</td>
<td>1565.78</td>
<td>100.00</td>
<td>1747.97</td>
<td>100.00</td>
<td>1829.45</td>
<td>100.00</td>
<td>1416.75</td>
</tr>
<tr>
<td>7)</td>
<td>No. of factories in operation</td>
<td>136</td>
<td>102</td>
<td>142</td>
<td>163</td>
<td>173</td>
<td>145</td>
<td>142</td>
</tr>
<tr>
<td>8)</td>
<td>No. of Factories submitted audited Annual Reports.</td>
<td>79</td>
<td>67</td>
<td>81</td>
<td>95</td>
<td>98</td>
<td>84</td>
<td>86</td>
</tr>
<tr>
<td>9)</td>
<td>No. of factories crushed more than average capacity</td>
<td>17</td>
<td>7</td>
<td>35</td>
<td>76</td>
<td>85</td>
<td>55</td>
<td>56</td>
</tr>
<tr>
<td>10)</td>
<td>No. of factories having cash conversion cost less than Avg. /cash conversion cost.</td>
<td>29</td>
<td>10</td>
<td>33</td>
<td>46</td>
<td>43</td>
<td>35</td>
<td>34</td>
</tr>
</tbody>
</table>

COP = Cost of production


114
Table No. 4.8: Indicates that the percent of cane cost is high. The percentage of components of cost of production of sugar for the year 2008-09 is mentioned in graphical form as follows.

**Percentage of total cost of Production.**

![Graph showing Percentage of total cost of Production.]

**Fig No. 4.3**

Table No.: 4.9

**The Comparative figure of Seven years of conversion cost of Maharashtra**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cane Cost %</th>
<th>Cash Conversion Cost %</th>
<th>Interest %</th>
<th>Depreciation</th>
<th>Conversion Cost %</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-04</td>
<td>60.91</td>
<td>19.84</td>
<td>15.81</td>
<td>3.43</td>
<td>39.00</td>
<td>100</td>
</tr>
<tr>
<td>2004-05</td>
<td>72.49</td>
<td>17.15</td>
<td>7.90</td>
<td>2.46</td>
<td>27.51</td>
<td>100</td>
</tr>
<tr>
<td>2005-06</td>
<td>76.91</td>
<td>14.97</td>
<td>5.41</td>
<td>2.71</td>
<td>23.09</td>
<td>100</td>
</tr>
<tr>
<td>2006-07</td>
<td>71.88</td>
<td>18.70</td>
<td>7.03</td>
<td>2.39</td>
<td>28.12</td>
<td>100</td>
</tr>
<tr>
<td>2007-08</td>
<td>71.31</td>
<td>18.44</td>
<td>7.85</td>
<td>2.40</td>
<td>28.69</td>
<td>100</td>
</tr>
<tr>
<td>2008-09</td>
<td>76.47</td>
<td>16.34</td>
<td>5.32</td>
<td>1.87</td>
<td>23.53</td>
<td>100</td>
</tr>
<tr>
<td>2009-10</td>
<td>81.67</td>
<td>12.98</td>
<td>3.56</td>
<td>1.79</td>
<td>18.33</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Financial Performance of VSI, year 2003-04 to 2009-10

The percentage of conversion cost to total cost of production has been decreased due to increase in cane cost during 2008-09.

**4.8 Cost Reduction In Sugar Production**

Cost Reduction Means to reduce the cost of production. Supply of good quality cane reduces cost of production. This can be effected by harvesting of cane on
maturity basis systematic transport of fresh cane with out loss of time is necessary to minimize losses due to deterioration. In the factory, cost of production can be effectively reduced by:

1) Improvement in extraction by milling.
2) Improved recovery by modern process techniques,
3) Fuel economy
4) Utilization of by products.
5) Improved design of machinery and lay - out.
6) Inventory and Material control.
7) Labour control
8) Maintenance cost control.
9) Expenditure control.
10) Manufactured of row sugar for export and refining.
11) Instrumentation.
12) Co - ordinated Research.
13) Selection of Machinery and Equipment
14) Economic considerations

1) **Mill Extraction**

   Mechanical cane unloading

   System and use of automatic cane feed control ensures uniform feeding of cane.

   To ensure proper preparation of cane "Preparation Index (PI)" is to be found out regularly in each shift. Preparation Index of about 80, which is expressed in terms of percentage of total pol in cane released in the form of broken cells, could easily be obtained by reducing the proportion to uncut cane using the split cane carrier, high powered cane knife drive, reversal of knives, use of shredders adjustment of clearance between the knife tip and carrier slat etc.

   High primary extraction can only be achieved by good preparation of cane, uniform and sufficient feed to crusher. proper roller grooving, adequate hydraulic loading and proper mill setting. Primary extraction of 65 % (on dry crushing) is considered good. Use of "Donnelley" type chutes ensure positive feeding to rollers.

   Imbibitions of 180 to 200 % on fibre at about 50 ºC gives satisfactory results. Effective imbibitions is done by injecting water into the bed of bagasse throughout the length for soaking the bagasse properly and uniformly. It can also be done by forced imbibitions system from top as well as bottom at the points where the bagass takes a
turn on the Intermediate carrier. Application of imbibition water at more than one place, has also been reported to give better results.

Efficiency of secondary extraction depends mainly on compound imbibitions system, roller grooving, hydraulic load on floating roller, mill setting, feeding to rollers and power of the prime mover, which are again dependent upon mill design and the condition of the plant.

2) Improved Recovery By Modern Process Technique.

1) Ion - Exchange Process :-

Ion - Exchange process for demineralisation of clarified sugarcane juice has been developed at the National Sugar Institute, Kanpur. The results of trials conducted at factories indicated that an increase in recovery by 0.7 to 0.9 % on cane, is obtained. The evaporators remain clean, molasses production is drastically reduced and are edible.

2) Process Without the Use of sulphur :-

a) Defeco - Melt crystallisation (DMC) Process

The process for the production of marketable white sugar without the use of sulphur, popularly known as DMC process, was developed at the National Sugar Institute, Kanpur and successfully implemented in a south Indian sugar factory. Later on the process was adopted in Maharashtra. Besides the various benefits, the cost of production is reduced by Rs. 3/- per quintal of sugar. Some of the benefits are as under.

1) Complete Elimination of sulphur which is an imported commodity. Lime consumption is also reduced to half.
2) Higher recovery of sugar which is mainly on account of reduced losses.
3) Reduction in cost of chemicals and labour required for periodical cleaning of evaporators.
4) simplicity - The cumbersome sulphitation process is replaced by simple and heat DMC system.
5) Longer equipment life because of reduced corrosive action.
6) Sugar Quality and Variety of choice -
7) Sugar produced is free from sulphate and chloride and hence suitable for pharmaceutical and industries. Raw sugar can also be produced as and when required.
8) Molasses produced is suitable for cattle feed.
b) Defeco-Melt phosflotation (DMP) Process -

DMP Process is an improvement over the DMC Process to produce superior quality sugar which cannot be produced by sulphitation and carbonation process. In DMP process clarification of melt is done by addition of phosphoric acid which is indigenously available and abundant. The process is based on the following observations.

1) On heating defecated and air impregnated sugar melt liquor floats the precipitate to the surface leaving the clear liquor under the froth.

2) Use of phosphate as flocculating agent results in formation of tricalcium phosphate floc, which has the property of occlusion and absorption of suspensoids, colloids and soluble colours. Some of these colours cannot be successfully handled by any other method.

The DMP Process has all the benefits of the DMC Process without use of sulphur. At the same time, it gives a superior quality sugar equivalent to refined sugar.

3) Fuel Economy

Cost of production can be appreciably reduced by making economy in fuel consumption. Fuel economy can be achieved by efficient generation of steam in efficient boilers, and also by economy measures in consumption of steam. Steam consumption is reduced by vapour bleeding form the evaporators i.e. juice heaters and vacuum pans, following the juice clarification process which reduces the scale formation such as ion - exchange, and producing small grain size only.

4) Profitable Utilization of Bye - Products -

Proper utilization of bye - products gives so much profit that the Cuban sugar Industry may consider "Sugar bye - product" of the sugar Industry.

a) By practicing fuel economy, much bagasse can be saved, which can be utilised for producing surplus power for selling outside or bagasse can be used for making paper.

b) Press mud is a valuable fertilizer containing undesirable wax. Wax which is a valuable raw material for chemical industry, can be extracted from the filter mud. This is already in practice in some factories.

c) Molasses is a raw material for alcohol industry and the recovery of potash as fertiliser from the effluents of the distillery, solves the problem of water and air pollution. Potash which is an imported commodity is obtained as a product from the waste.
5) **Improved Design** -

Design of machinery and layout plays an important role in reducing cost of production. Besides the operational maintenance and safety aspect, it minimises the losses due to entrainment leakages, inversion etc. An improved design also helps better extraction and recovery of sugar.

6) **Inventory and Material control** -

Machinery of improved design, good layout planned and preventive maintenance all help in reducing Inventory for spares. Selection of suitable process also helps in reducing the cost of spares and replacement by establishing the levels of inventory and usage levels all use of materials against the budgeted standards, it will be possible to bring down inventory holding cost as well as waste of material in the product cost.

7) **Labour Control** -

Specialised Selection and training contribute to improve areas of control, in that right worker at the rights spot will save in cost while misplaced worker may lead to costly errors, waste of time and often comes in the way of others.

In this regard, the National sugar Institute has been doing good service to the industry, providing properly trained personnel.

In the area of labour control, the supervisors must see that available labour are made best use of and the data furnished for requirement and utilisation are factual and accurate.

8) **Maintenance cost control** -

One of the control aspects which has got a great relevance in sugar factory is the control of maintenance which is very substantial. It is necessary to establish tight budget and work within the limits of the budget sanction. The complete requirement budget should be prepared will in advance to ensure that only essential maintenance expenditure is incurred.

9) **Expenditure Control** -

It is necessary to establish detailed expenditure budget for each item of expenditure and this is to be scrutinised with relevance to the season in terms of the length of the season in terms of the length of the season and capacity utilization etc. and every item of expenditure actually incurred must be compared to the budgeted values. For this purposes the expenditure so incurred should be analysed into variable and fixed overhead expenses.
10) Manufacture of raw sugar for export and refining -

Raw sugar has wider export market. It is easy to manufacture and handle in bulk. In cane sugar factories they produce raw sugar only, 75 percent of which is exported and 25 per cent is refined in their own centralized refineries for internal consumption.

Plant for producing raw sugar is much simpler and less costly than the direct plantation white sugar plants. Existing plant can be used for production of raw sugar also. While some of the equipments will be surplus and the plant's capacity will be increased by about 25 % and the steam consumption will be reduced by about 10 per cent.

White sugar is produced better in modern plants. The old plants, Where it is difficult to produce good quality sugar, can be selected for producing raw sugar.

Sugar factories can be divided in to different groups according to the plant condition location and availability of cane.

a) Modern factories, having facilities, can produce superior quality. White sugar for special uses and 'Janata' as well for common people.

b) A group of nearby factories can produce raw sugar which will be refined in a centrally located clarifying unit. Refining cast of raw sugar at the central clarifying unit, is about Rs. 9/- per quintal of sugar.

c) Factories which are scattered and away from the central refinery or from the port, can produce only "Janata" sugar equal to present E- 29 by following DMC process.

d) Factories situated near the ports can produce only raw sugar for export purposes.

11) Instrumentation -

Proper instrumentation helps efficient running and control of Boiler, Turbo -alternators and automatic units. Besides for better process control with improved efficiency and through put the common instruments like indicator and recorder for temperature, pressure/ vacuum and PH, meters and recorder for boiler feed water, imbibitions water for filter and movement water in pans, conductivity meter for pans and steam flow meters and recorders are essential.

12) Co-Ordinated Research -

A lot of research work is being carried out in the Institutes, Universities and Research Centers. Some study and development work are done in individual factories also mainly to solve their own problems. But what is needed is a coordinated research
so that the research becomes result oriented to produce more at reduced cost. Efforts are already afoot in this direction.

Reduced Cost of production by the method suggested above, will meet the official commitment in lowering the prices of essential commodities and will also help to promote export market and at the same time safeguard the interest of the industry.

13) Selection of Machinery and Equipment -

a) Design Considerations -

The maintenance function starts with the design of the equipment. If the designer has access to previous experience related with maintenance of similar equipments and if he has practical experience as regards the maintenance of equipment such as he is in the process of designing, he can do a lot to reduce the amount of maintenance of equipment such as he is in the process of designing, he can do a lot to reduce the amount of maintenance required and to facilitate the execution of such maintenance as has to be carried out. The designer can choose such materials and dimension the various components in such a way as to ensure that the equipment will withstand all anticipated stresses and strains. It can also be ensured by him that the equipment can be easily dismantled during repair or replacement.

The designer should always aim that cheaper components give way or wear first before the defect can damage the more expensive part. A near analogy is that of a fuse in an electrical system.

14) Economic Considerations -

1) When purchasing equipment, it is important to take into account its maintenance characteristic. Cheap equipment necessitating considerable maintenance can in due course prove more costly than expensive equipment requiring little maintenance. The purchasing cost constitutes, after all only a part of cost involved throughout. Life of equipment i.e. the purchase price plus maintenance costs during the entire service life of the equipment. Moreover the equipment costing less and having too many breakdowns will in minimize the productivity causing great loss to the factory.
The characteristics in Fig. No. 4.4 show the development of costs from purchase to disposal.

1) Low - quality equipment
2) High - quality equipment

Fig No. 4.4 : Maintenance Cost characteristic.

Equipment which is easily maintained may be comparatively expensive to buy but once the teething problems are overcome, the maintenance cost will be low for a long period of time. Besides, the useful life of equipment depends to some extent on the case with which it can be maintained. If maintenance is difficult, running in problems tend to be more serious and the maintenance costs throughout the life of the equipment are higher than that with a better design.

The investment on purchase and maintenance should be decided considering:

a) Down time costs comprising - Loss of profit for the period that the machine remains idle for maintenance work.
b) Wages paid to the labour while the machines remain idle.
c) Depreciation of the machine for the same period of time.
d) Overheads proportion for the period of machines idleness.

2) Cost of maintenance labour and overhead of maintenance department.
3) Cost of stores and spares used for the repairs and maintenance work.
4) Capital investment for replacement of machines/ components.

3) Layout Construction of Foundation and erection of machinery and equipment-

Fetch equipment or a group of equipments should be installed in a manner which provides adequate space for future expansion. Each machine should be easily accessible for inspection and repairs works. The good layout facilitates staff in the factory for better maintenance and monitoring of the condition of the equipment.
Adequate arrangement of light and ventilation is necessary. The factory should be kept neat and clean and healthy environment should be created.

The machinery foundation should be economically designed and correctly constructed. The foundations of machines subject to heavy vibrations should be taken special care of.

Erection should be accurate, smallest mistake committed at the time of erection may be a source of constant trouble. The proper alignment and leveling of moving equipment is absolutely necessary. Proper grouting of holding down bolts, proper installation of lubricating system and cooling arrangements and faultless assembly of the equipment are equally important. The faulty erection and assembly increases wear and tear and the down time.

4) **Equipment Cards -**

Equipment cards giving informations with regard to specifications, make suppliers name and address and cost of the equipment should be maintained. Help o these information's should be taken for reference purposes and for procuring genuine spares.

5) **A descriptive record of repairs and replacement -**

A descriptive record of repairs and replacement on equipment / components should be maintained. This will also contain the nature and reason of failures of the equipments during the operational periods. Such records will help in future planning. Moreover, this will enable to study the behavior of the machines which is so essential for carrying out proper repairs and improving the reliability.

6) **Work Order System -**

Maintenance work order control is a method by means of which every type o maintenance job is covered by a standard written form which shows that the work is needed, is adequately described, is properly approved and is issued by a proper authority. This enables to analyses estimate and schedule the work. This also offers a follow up procedure to access the progress and completion of work.

7) **A report on Outstanding Work -**

There should be a system to prepare a report on outstanding work every day. This report should be given to a proper authority for follow up.

8) **Record of Frequency of Breakdown -**

Frequency of breakdowns report should be maintained for each machine which materially influences production. A machine remains down either for
scheduled work or for unexpected breakdowns. This work is necessitated either because of improper maintenance or design defect or poor operation. Therefore it becomes necessary to determine the reason for a breakdown and take suitable action in this regard.

9) **Work implication in Maintenance** -

   Effort should always be made in this direction. With implication of the work, the time and cost of repairs are reduced considerably.

10) **Workers participation and motivation aspect** -

   A sense of participation by the workers is vital for the growth of the industry. They should be given due importance in the planning and execution of the maintenance work. Shop floor level and plant level committees may be formed in which representatives of workers should also be associated.

4.9 **Professional Managements in cooperatives**-

   The essential feature of a cooperative organization is its character of democratic management. Here the principle of ‘one man one vote’ is strictly followed, irrespective of number of shares held by a member. The board of director is elected by the members and in turn the chairman is elected. This is followed by the authority following from the chairman to the general manager or the chief executive downward to the ultimate employees.

   Members - The general body
   ↓
   Board of Directors
   ↓
   Chairman
   ↓
   Managing Director
   ↓
   General Manager
   ↓
   Other Employees

   **Fig No. 4.5 : Execution of Management Decisions**

   The professional manager is expected to assume broader responsibilities for the conduct of the enterprise as an economic and social institution. Professionalized management would ensure higher level of productivity, bringing about a higher rate of economic growth and higher standards of living for the masses.
4.10 Calculations for the Daily Manufacturing Report - 

1) Brix % Cane :
   \[ \text{Tonnes Brix in cane} \times 100 \]
   \[ \text{Tonnes Cane} \times 100 \]

2) Pol % Cane :
   \[ \text{Tonnes Pol in cane} \times 100 \]
   \[ \text{Tonnes cane} \times 100 \]

3) Fibre % cane :
   \[ \text{Tonnes Fibre} \times 100 \]
   \[ \text{Tonnes cane} \times 100 \]

4) Mixed Juice % cane :
   \[ \text{Tonnes Mixed Juice} \times 100 \]
   \[ \text{Tonnes cane} \times 100 \]

5) Mill Extraction (e) :
   \[ \text{Tonnes Pol in mixed juice} \times 100 \]
   \[ \text{Tonnes Pol in cane} \times 100 \]

6) Recovery percent cane :
   \[ \text{Tonnes Sugar} \times 100 \]
   \[ \text{Tonnes cane} \times 100 \]

7) Molasses percent cane :
   \[ \text{Tonnes Molasses} \times 100 \]
   \[ \text{Tonnes cane} \times 100 \]

8) Boiling House Recovery (ESG)
   \[ \frac{\text{Sucrose (or Pol) in sugar Produced} \times 100 (J - M)}{\text{Sucrose (or Pol) in mixed juice} \times J (100 - M)} \]

9) Reduced Boiling House Recovery (ESG) Gunda Rao (R85) :
   \[ R (85) = r + K \frac{M}{1 - M} \times \frac{(17 - 20J)}{17 J} \]

10) Conversion of raw sugar into recovery into equivalent white commercial sugar recovery :
   \[ ESG = P \times \frac{S (J - M)}{K (S - M)} \]

Where ESG = Equivalent standard Granulated

\[ P = \text{Pol} \% \text{ sugar} \]
S = 100

M = Purity of final molasses

J = Purity of Sugar = \frac{\text{Pol \% Sugar}}{100 - \text{Moisture \% Sugar}} \times 100

\text{Recovery White Sugar} = \frac{\text{ESG Raw Sugar} \times \text{Recovery Raw Sugar}}{\text{ESG White Sugar}}

Source - Books from "System of Technical Control for cane sugar factories in India." by N. C. Varma.
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