CHAPTER 7

RESULTS AND DISCUSSION

From the measurements taken after implementing the corrective actions (calculations of concentration levels for 1024 readings shown in 8 Tables and 32 Graphs in Chapter 6), it is observed that the toxic substances in the weld fumes are well within the acceptable TLV level of 5 mg/cu.m. This improvement is mainly due to the following changes made in and around the Panel Welding Machines.

7.1 IMPROVEMENTS IN WORKING CONDITIONS

i. The Local Exhaust Systems mounted on each of these machines prevented the fumes to enter into the area where the welders are standing and doing their work.

ii. The Eight Fume Exhausters installed at a height of 4m on all columns of shop floor, effectively sucked and sent the fumes generated to the atmosphere through the centrifugal blower provided in the system.

iii. The 6 local exhaust flexible hoses arranged over the weld beads just after the rollers of the machines are connected to one ID fan. This has resulted in sucking the slag dusts formed effectively reducing the toxic contaminations of the Welding Slag Dusts generated from Submerged Arc welding (SAW) process.
iv. The openings of up to 2.5m made on all peripheral walls of the shops made entry ventilation. This has resulted in dilution and evacuation of the fumes effectively.

v. The curtain provided by colored glass to shade No: 11 and size 1mx 1m, enables the welders to see the tubes through their naked eyes while they are welding, and adjust the machine controls, without affected by any arc radiation in their skin and eyes, and also prevented the welders against heat and radiation and concentrate and control the welding torches then and there.

vi. All welders are issued with welding mask, gloves, special clothing, safety shoes etc., They are also insisted to wear fume respirators as an additional safety against the hazard of fumes. This is an additional safety precaution against fumes respiration for the welders. The welders are very happy in wearing these fume respirators. Also all the improvements recommended against points 5.1 to 5.6 in chapter 5 are implemented for the safe working of the welders.

vii. All the 72 welders health conditions were once again checked completely after working for 1 year after installation of the suggested improvements. The 4 welders who were identified as having lung-cancer were now completely alright. Also there was almost no respiratory and eye problem among other welders who were earlier affected by them.

The improved and better ventilation system has created an amicable environment for the welders to work safely so that good quality panels without any welding defects are manufactured from these eight panel welding machines.
7.2 PRODUCTION ACHIEVED AFTER IMPLEMENTATION OF CORRECTIVE MEASURES

With the above changes made there is appreciable increase in production and reduction in welding rework. The details of increase in production and profit and decrease in the rework cost are calculated for one year. The production per shift achieved in each machine is 2 panels, each comprising of about 360 Meters in weld length. This output is 200% of the production achieved before effecting the above changes and alterations. Also there is a saving of more than 10% of cost of production due to manufacture of quality panels without any welding defects, eliminating the rework cost.

7.3 COMPARISONS OF PERFORMANCES BEFORE AND AFTER IMPLEMENTATION OF CORRECTIVE MEASURES

7.3.1 Comparisons of Production Achieved

Table 7.1 given below shows the details of Production achieved in Physical and Financial after Implementation of Remedial Measures. Comparisons productions from Table 4.1 and Table 7.1 for 1 year before and after Implementation of corrective actions made are shown in following figures,

1. Figure 7.1 shows the comparison of Production of Panels in Numbers for 1 Year before and after Implementation of Suggestions.

2. Figure 7.2 shows the comparison of Production of Panels in MT for 1 Year before and after Implementation of Suggestions.

3. Figure 7.3 shows the comparison of Value of Production for 1 Year before and after Implementation of Suggestions.
4. Figure 7.4 shows the comparison of Profit, Rework Cost and Net Profit for 1Year Before and After Implementation of Suggestions.

Table 7.1 Details of Production achieved in Physical and Financial after Implementation of Remedial Measures

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Details</th>
<th>No of Panels</th>
<th>Weld Length in Meters</th>
<th>Weight in MT/ Value in `</th>
<th>Value in US $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Production per Machine per Shift</td>
<td>2 Nos</td>
<td>720 Meters</td>
<td>14 MT</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>Production per Machine Per Day (3 Shifts)</td>
<td>6 Nos</td>
<td>2,160 Meters</td>
<td>42 MT</td>
<td>–</td>
</tr>
<tr>
<td>3</td>
<td>Production in all 8 Machines for 1 Day</td>
<td>48 Nos</td>
<td>17,280 Meters</td>
<td>336 MT</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>Production in all 8 Machines for 1 month</td>
<td>1,200 Nos</td>
<td>4,32,000 Meters</td>
<td>8,400 MT</td>
<td>–</td>
</tr>
<tr>
<td>5</td>
<td>Production in all 8 Machines For 1 Year</td>
<td>14,400 Nos</td>
<td>51,84,000 Meters</td>
<td>1,00,800 MT</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td>Cost of Production of 1,00,800 MT panels @ ` 1.0 Lacs per MT</td>
<td>-</td>
<td>-</td>
<td>` 1,008.00 Crores</td>
<td>$22.4 Million</td>
</tr>
<tr>
<td>7</td>
<td>Profit @ 15% of cost of production (Rs 1,008.00 Crores x 15%)</td>
<td>-</td>
<td>-</td>
<td>`151.20 Crores</td>
<td>$3.36 Million</td>
</tr>
<tr>
<td>8</td>
<td>Cost of Rework on Panels Due to Welding Defects.</td>
<td>-</td>
<td>-</td>
<td>`5.00 Crores</td>
<td>$0.11 Million</td>
</tr>
<tr>
<td>9</td>
<td>Net Profit = Profit – Cost of Rework</td>
<td>-</td>
<td>-</td>
<td>`146.20 Crores</td>
<td>$3.24 Million</td>
</tr>
<tr>
<td></td>
<td>= (Col. 7 – Col. 8 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Increase in Profit due to Suggestions Implemented</td>
<td>-</td>
<td>-</td>
<td>`121.00 Crores</td>
<td>$2.68 Million</td>
</tr>
<tr>
<td></td>
<td>= (`151.20 Cr – 25.20 Cr)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exchange rate of US $1.0=Indian Rupees of ` 45.0 is taken.
Figure 7.1  Comparison of Production of Panels in Numbers for 1 Year before and after Implementation of Suggestions

Figure 7.2  Comparison of Production of Panels in MT for 1 Year before and after Implementation of Suggestions
Figure 7.3  Comparison of Value of Production for 1 Year before and after Implementation of Suggestions

Figure 7.4  Comparison of Profit, Rework Cost and Net Profit for 1 Year Before and After Implementation of Suggestions
Hence due to these improvements there is an increase in Profit of `121.00 Crores (US $2.68 Million) per year from all 8 Panel Welding Machines, i.e., from the previous profit of `25.20 Crores (US $0.56 Million) for 50,400 MT of panel production to `146.20 Crores profit (US $3.24 Million) for 1,00,800 MT of panels production which is very much appreciable and is recurring for every year.

7.3.2 Improvement in Quality of Water Wall Panels Welded

There is appreciable improvement in the Quality of water wall panels welded after implementation of corrective measures. Comparison of number of weld defects – weld off line, discontinuity, porosity and slag inclusions before and after implementation of corrective measures are shown in Figure 7.5.

![Graph showing comparison of weld defects](image)

**Figure 7.5** Comparison of Weld Defects Per Panel for Before and After Implementation of Corrective Measures
7.3.3 Comparison of Causes for Accidents, Working Conditions and Health Problems

7.3.3.1 Improvement in Elimination of Hazards

Figure 7.6 shows the comparison of Hazards reported for the 72 welders working in water wall panels welding machines before and after implementation of corrective measures taken from the accident records of Factory Occupational Health Centre.

![Figure 7.6 Comparison of Hazards Reported by 72 Welders Before and After implementation of Corrective Measures](image)

7.3.3.2 Feedback from Welders about their Working Conditions

A questionnaire with 100 queries have been prepared and feedbacks received from all 72 welders about their working conditions. The feedbacks were consolidated and shown in Figure 7.7, which shows the comparison of Feedback Given by the 72 welders working in water wall panels welding machines before and after implementation of corrective measures taken about their working conditions.
Figure 7.7 Comparison of Feedback Given by 72 Welders about their Working Conditions Before and After implementation of Corrective Measures

7.3.3.3 Improvement in Welders’ Health Conditions

Figure 7.8 shows the comparison of Hazards reported for the 72 welders working in water wall panels welding machines before and after implementation of corrective measures taken from the records of Factory Medical Centre.

Figure 7.8  Comparison of Health Records of 72 Welders Before and After implementation of Corrective Measures
The above three Figures 7.6, 7.7, and 7.8 shows the improvements in welders’ health and working conditions due to the corrective measures implemented.

Figure 7.9 shows the certificate got from the shop floor authority of the factory to substantiate for the increase in production and better work environment.

Figure 7.9 Certificate issued by the Shop Floor Authority for the Improvements in Welders’ working conditions and Productivity