



ENERGY AUDIT
In
FERRO ALLOY INDUSTRY

Case Study
SAI CHEMICALS (P) Ltd.
*Plot No. 63/649, Village-Tedesara,
Rajnandgaon (C.G.)*

BY
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EXECUTIVE SUMMARY

- 1. Unit : M/s. SAI CHEMICALS (P) LTD.
Plot No. 63 / 349,
Village – Tedesara, Rajnandgaon (C.G)
Ph. No: (0788) 2285017/ 2211682**
- 2. Product : High Carbon Silico Manganese & Ferro
Manganese.**
- 3. Main section of the plant : Submerged Electric Arc Furnace**
- 4. Raw Material Consumption : 26892.277 MT
Year (2008-09)**
- 5. Annual Production : 5452.825 MT
Year (2008-09)**

- 6. Energy Used Per Year : 19,772,400kWh, Rs.637.13 Lacs.**
Year (2008-09)
Electricity (kWh)
- 7. Proposed Energy Saving : 10484023 kWh, Rs. 353.16 Lacs**
Electricity
- 8. Expenditure to be incurred : Rs. 28.07 Lacs**
onwards implementation of
Recommendations
- 9. Additional annual Operating : NIL**
& Maintenance cost on
Implementation of
recommendation

- 10. Net Annual Savings : Rs.353.16 Lacs**
- 11. Av. Simple Payback Period : 1 Month**
- 12. Average Percentage Savings : 41 %**
- 13. Commencement & Completion of Energy Audit : September'09 to Oct'09**

INTRODUCTION

- ◆ **Installed capacity : 7.6 MVA (3.6 MVA & 4 MVA)**
- ◆ **High carbon Ferro manganese : Smelted by continuous process in three phase open – top electric arc furnace.**
- ◆ **Ferro manganese contains at least 45% of manganese.**
- ◆ **Smelting process includes:**
 - 1.Preheating of the materials**
 - 2.Drying and removing of volatiles**
 - 3.Reduction of oxides,**
 - 4.Melting of the metal and slag**

COMPONENTS OF PRODUCTION COST

Raw Material

- ◆ **Main raw material** : **Manganese ore, Coke, Steam Coal, Lime Stone, Quartz, Dolomite, Carbon Paste, Slag & Iron Ore**
- ◆ **Raw material consumed (Year 2008-09)** : **26892.277 MT**
- ◆ **Reduction Agent** : **Pearl Coke & Steam Coal**
- ◆ **Consumption (Year 2008-09)** : **5604.68 MT**
- ◆ **Auxiliary Service** : **Gas (Negligible Quantities)**

UTILITIES

1. Auxiliary Load : 650 kVA,
33 kV / 0.44 kV
- a) Lighting & Fan : 2.7 kW
- b) Pumps, Conveyors
blowers, skip hoist & Misc Load : 153.9 kW

2. Water

- a) DM water requirement : 18000 cu. Meters/ hour
- b) Maximum water requirement : 4,32,000 cu. Meter/ day
- c) Source : Bore well

ENERGY USED

◆ Contact Demand	:	6700 KVA
◆ Total Energy Consumption (Year 2008-09)	:	26581696 kWh
◆ Purchased from CSEB	:	19772600 kWh
◆ Used from Captive Power Plant	:	6808896 kWh

PRODUCTION (5453 MT)

◆ High Carbon Ferro Manganese	:	385 MT (7 %)
◆ High Carbon Silico Manganese	:	5068 MT (93 %)

PROCESS DESCRIPTION

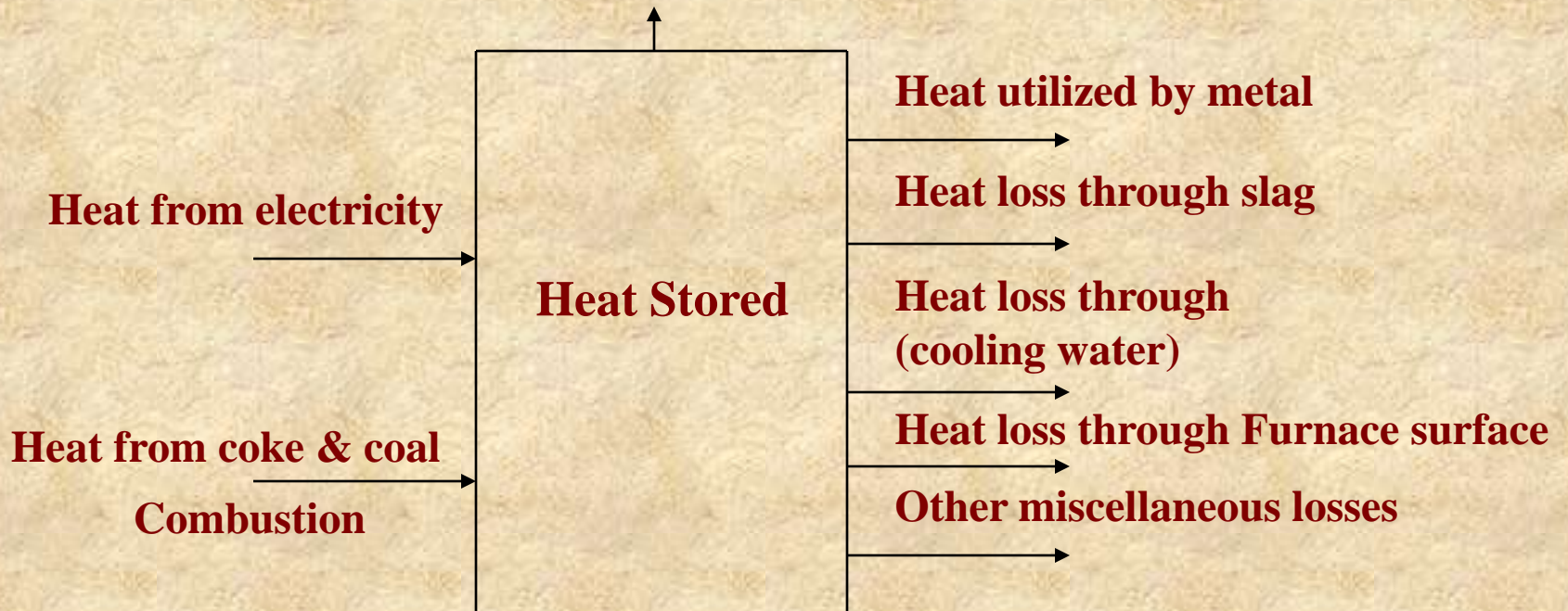
- ◆ **Raw Material Charging** : Blending of Mn Ore from various mines as per the suitability & maintaining the percentage of Mn in the charging ore.
- ◆ **Immersion of Electrodes** : Electrodes is maintained at a depth of 1100-1400 mm with their ends being spaced 800-100 mm from the furnace bottom. The temperature is covered with a layer of charge 1200-1500 thick.
- ◆ **Tapping** : Metal & slag are tapped from the tap holes. Slag ratio in the smelting of Ferro manganese is within 1 to 1.5.

ANALYSIS OF ENERGY CONSUMPTION PATTERN

- ◆ **Main Product** : **High Carbon Silico Manganese**
- ◆ **Specific Energy Consumption** : **3765 kWh/T to 9869 kWh/T**
- ◆ **Average Energy Cons.** : **4875 kWh/MT**

ENERGY & MATERIAL BALANCE

Heat loss in flue gas



MATERIAL BALANCE

◆ Average % Mn in Charged ore	:	27.42%
◆ Av. Percentage of carbon in coke/coal/Charcoal	:	53.87%
◆ SiMn Production per day	:	16,000 kg
◆ Slag per day	:	24,000 kg
◆ Input Per day	:	57200 kg
◆ Output Per day	:	16000 kg (Si Mn)
	:	24000 kg (Slag)
	:	3200 kg (Flue Gases & losses)

ENERGY BALANCE

HEAT UTILIZATION EFFICIENCY OF 3.6 MVA ARC FURNANCE:-

Total Heat I/p Q1 = 67096295KCal

Total heat Utilized Q2 = 22362244.2KCal

Efficiency = Output/Inputx100%

= 22362244.52/67096295 x 100

= 33 %

IDENTIFICATIONS & RECOMMENDATIONS

In the year 2008-09 the existing heat utilization efficiency is only 33% and 67% of heat is going to waste.

- a. The major portion of heat is wasted through open top of Arc-furnace popular in India due to many technical and commercial reasons.**
- b. The good amount of heat is loosed through the furnace surface from surroundings and bottom portion.**

Heat losses through furnace surrounding

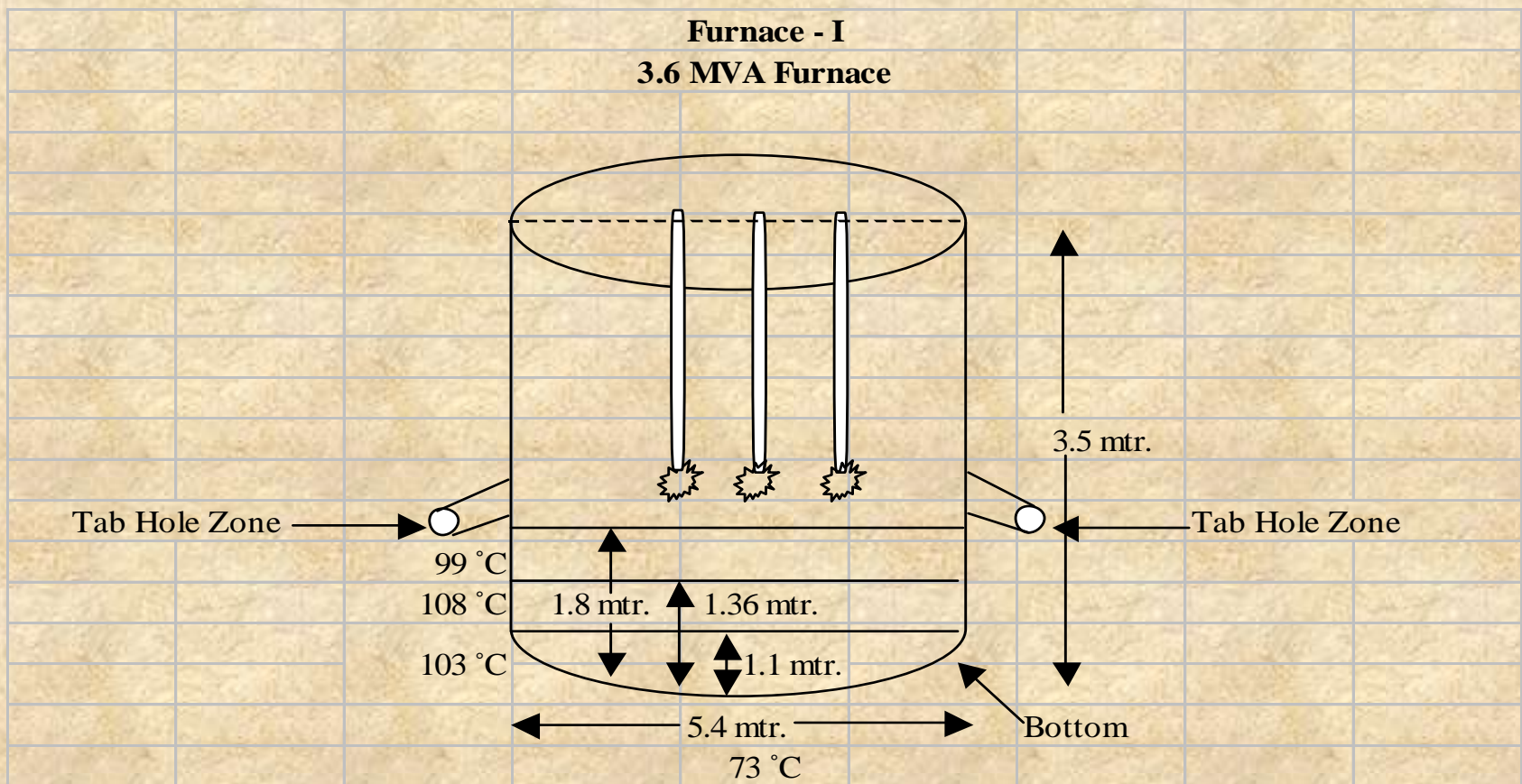
a) From 3.6 MVA furnace : 243492 Kcal/hr.

Heat losses through furnace bottom

a) From 4 MVA furnace : 39153 Kcal/hr.

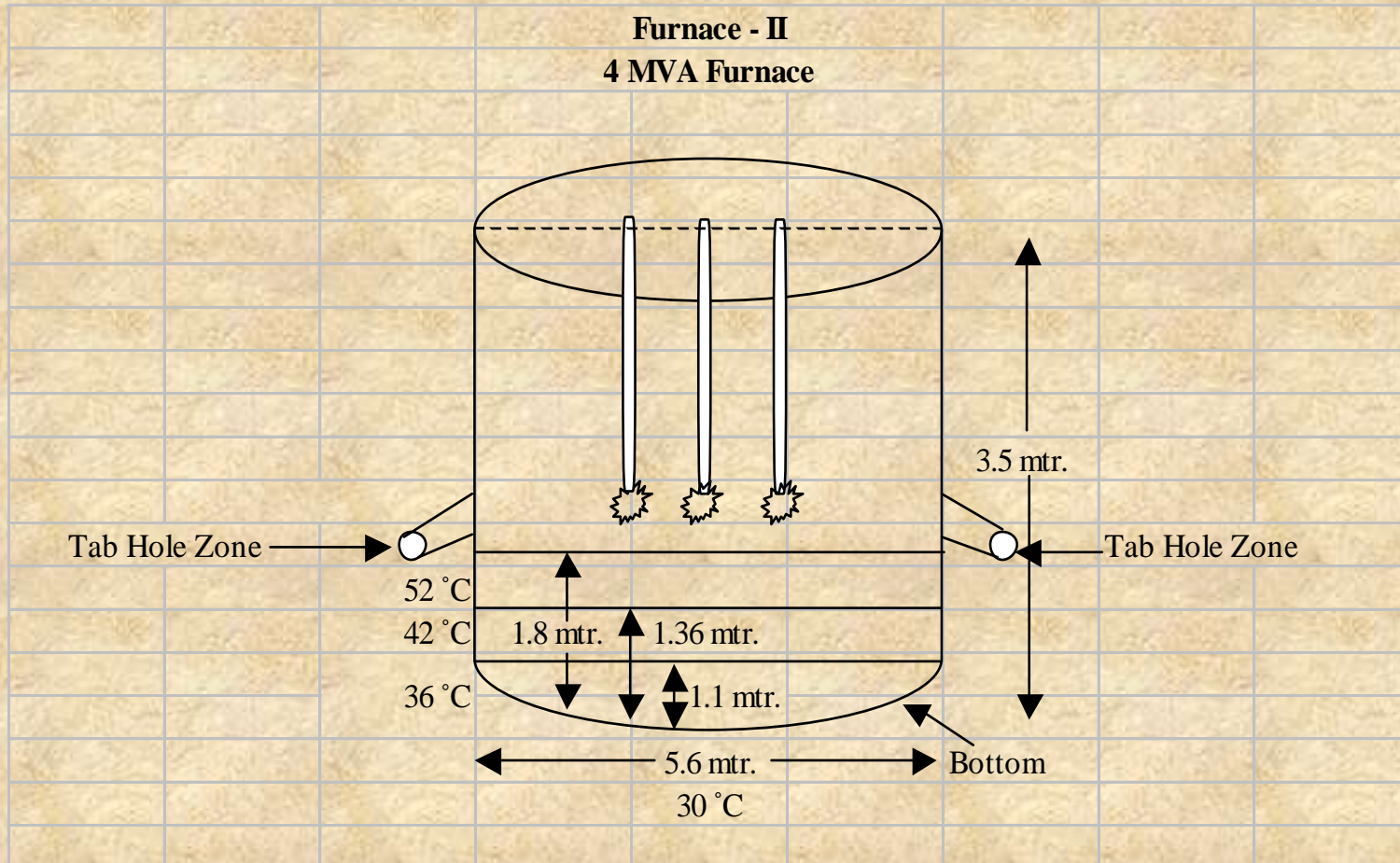
FURNACE – I, 3.6 MVA FURNACE

Heat Utilization efficiency - 33 %



FURNACE – II, 4 MVA FURNACE

Heat Utilization efficiency – 37 %



RECOMMENDATION IN SAI CHEMICAL

1. Improvement in insulation of furnace shell:

- a) On wall side:**
- 1. First layer of 40 mm refractory grog**
 - 2. Second layer of 10 mm millboard**
 - 3. Third layer of 380 mm high alumina refractory bricks.**
- b) On furnace:**
- 1. First layer of 40 mm refractory grog
Bottom**
 - 2. Second layer of 10 mm millboard**
 - 3. Third layer of 380 mm high alumina refractory bricks.**
 - 4. Fourth layer of 500 mm carbon paste.**

◆ **Estimated saving in heat losses : 141323 Kcal/h**

◆ **Improvement in Efficiency : 4 %**

◆ **Annual Estimated Savings in kWh : 914410 kWh**

2. Optimum Capacity Utilization of Furnaces : By optimum utilization of both the furnaces, the specific consumption can be brought to level of 4000 – 4875 kWh/ton.

◆ **Estimated Energy Savings per ton : 3492 kWh**

**3. Improvement in Power factor & reduction in MD :
By installation of capacitors banks in 3.6 MVA & 4
MVA.**

Existing Power factor	: 0.87 – 0.96
Improved Power factor	: 0.99
Savings due to low PF penalty	: Rs. 35937.00
Savings due to Excess MD	: Rs. 204600.00

**4. a) Replacement of 25 Nos. Conventional tube light fittings
with energy efficient T-5 fittings.**

**b) Replacement of 6 Nos. HPSV light fittings with 150 W
Metal Halide fittings**

CONCLUSION

- ◆ The heat utilization efficiency can be increased 33 % to 37% by improvement in furnace insulation.
- ◆ 914410 kWh of cost Rs. 29.44 lacs can be saved by expenditure of Rs.8.31 lacs, simple pay back – 3.39 Months.
- ◆ The 9565788 kWh electricity of cost Rs. 308 Lacs can be saved per year by optimum capacity utilization of furnace.
- ◆ By installation of additional Capacitors of 4 x 98 KVAR, Rs. 15.60 lacs penalty of low PF & excess MD can be saved.
- ◆ By replacement of old Lightings Fittings with energy efficient Fittings, 3825 KWH of cost Rs. 0.12 Lacs can be saved by expenditure of Rs. 0.16 lacs, simple pay back – 16 Months.

many thanks

Many thanks to you.