Report

On

# Performance test of Boilers

By

**DSCL Energy Services Company Limited**
**New Delhi**

**Project - Boiler Efficiency measurement and recommendation to improve efficiency**

## 1. Introduction

The Dhampur Sugar Mills Ltd. has awarded a contract to DSCLES for performance evaluation of existing boilers and recommendation to improve the energy efficiency of Boilers. DSCL ES conducted boiler efficiency measurements on 2nd to 15th April 2006. Indirect method ASME PTC 4.1 was used for the calculation and losses were identified by field measurements.

## 2. Measurements & Observations

Measurements:
Following areas were covered during the test for measurements:

a. Water/ Steam parameters.

- Temperature & Pressure measurements of water at Economizer inlet and that of steam at boiler outlet.
- Steam flow rates.
- DM water quality

b. Fuel

- Collection of Fuel samples.
- Ultimate analysis of the Fuel(Enclosed as Annexure-I)

c. Flue gas/Ash analysis

- Collection of Ash samples for un burnt analysis.(Enclosed as Annexure-II)
- Online readings for Flue gas analysis(Enclosed as Annexure-III)

d. Surface Conditions

- Measurements of Surface Temperatures.(Enclosed as Annexure-IV)

Observations:
Following observations were made for the different sections.

e. Boiler Combustion System

- There were fluctuations in the load and boiler are over loaded up to25% of rated capacity, when ever one of the boilers face problem.

- CO2 and O2 levels in the flue gas contents were very high.
- Flue gas temperature from the last heat recovery unit was about 190 to 200 °C
- The radiation losses is about 5.1% against norm of 0.8 to 1.5 %
- Heavy leakage and inflow of air is there.

f. Feed water & drum water control

- Temperature of the inlet water to the economizer was running around 65 °C against 105 Deg C.
- The drum level control was functioning satisfactory.

## 3. Calculations & Analysis:

Boiler Efficiency Estimation**:** The efficiency of the boiler was calculated by Indirect method & considering the GCV basis method of losses measurement. In this method individual area of loss is quantified. The results obtained are tabulated below.

**Table: Boiler Losses / Efficiency Estimation**

| S.N. | Description of losses | Unit | Pre-Project | Guaranteed |
|---|---|---|---|---|
| 1 | Loss due ash/refuse | % | 0.44 | 0.05 |
| 2 | Loss due to radiation & convection | % | 3.8 | 1.05 |
| 3 | Loss due to bow-down | % | 1.85 | 1.35 |
| 4 | Loss due to flue gases | % | 35.3 | 31.6 |
| 7. | Total losses(% ) | % | 41.39 | 34.0 |
| 8 | Efficiency (%) | % | 58.61 | 66.0 |
| 9 | Steam raising ratio | kg/kg | 1.5 | 2.10 |

## 4. Recommendations

Oxygen Control: Due to heavy leakage through ducting and casing, there are very high oxygen contents in the flue gas. This is to be maintained within limit by attending the leakages.

Combustion Control: With the automation of combustion control, the fluctuation in the exhaust temperature, furnace temperature and oxygen level in flue gas will be controlled and maintained.

Exit Flue Gas Temperature: Exit flue gas temperature should be lowered to 150 Deg C by regular cleaning of APH as a standard maintenance practice or, if required, area of APH may be increased.

De-aerator Temperature Improvement: The deaerator outlet temperature of feed water should be maintained as 105 Deg C. This will improve the efficiency as well as life of the boiler.

## Annexure - I

| Ultimate Analysis of Baggasse | | |
|---|---|---|
| Ash | 1.25 | % |
| Carbon | 23.5 | % |
| Sulphur | 0.00 | % |
| Nitrogen | 0.00 | % |
| Hydrogen | 3.25 | % |
| Oxygen | 22.0 | % |
| Moisture | 50.0 | % |
| GCV | 2074 | kcal/kg |

## Annexure - 2

| Ash Unburnt Analysis ( % of Ash) | | |
|---|---|---|
| Sample-1 | 8.1 | % |
| Sample-2 | 8.3 | % |
| Sample-3 | 7.1 | % |
| Sample-4 | 7.8 | % |
| Sample-5 | 7.5 | % |
| Sample-6 | 8.2 | % |
| Average | 7.83 | % |

**Annexure - III**

# Flue Gas Analysis

**(As measured on 05.04.2006)**

| Time | % $O_2$ |
|---|---|
| 10:00 | 14.5 |
| 10:30 | 10.5 |
| 11:00 | 11.8 |
| 11:30 | 12.3 |
| 12:00 | 11.6 |
| 12:30 | 13.5 |
| 13:00 | 13.6 |
| 13:30 | 9.9 |
| 14:00 | 11.7 |
| 14:30 | 10.9 |
| 15:00 | 10.5 |

**Annexure-IV**

# Average Boiler Surface Temperatures

**(As measured on 12.04.2006)**

| **Economizer** | **Average Temp (Deg C)** |
|---|---|
| Wall 1 (DA) | 88 |
| Wall 2 (CR) | 95 |
| Wall 3 (FE) | 93 |
| Wall 4 (CH) | 89 |
| Roof | 97 |
| Furnace | |
| Wall 1 (DA) | 102 |
| Wall 2 (CR) | 104 |
| Wall 3 (FE) | 103 |
| Wall 4 (CH) | 107 |
| Roof | 107 |
| | |
| Bank Tubes | |
| Wall 1 (DA) | 98 |
| Wall 2 (FE) | 95 |
| Horizontal Area | 96 |
| | |
| Dust Collector | |
| Wall 1 (DA) | 88 |
| Wall 2 (FE) | 84 |
| Wall 3 (CR) | 88 |
| Wall 4 (CH) | 87 |
| Horizontal Area | 89 |