ECONOMICALLY ANALYSIS OF REGENERATIVE AIR PREHEATER IN THERMAL POWER PLANT

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Abstract - This paper presents economic analysis of Regenerative air preheater in thermal power plant. This work is focus on performance of air preheater, before and after axial seal plate, radial sector plate clearance adjustment. This work based on routine operation data measured onsite at Chhabra thermal power project, Rajasthan, India. The Air preheater is a rotating device that transfers heat from flue gas to incoming cold air for combustion in the furnace. Modern power plants are uses air preheater as auxiliary of boiler. Air preheater reduces coal consumption due to waste heat recovers from flue gas. Boiler efficiency increases due to utilize of waste heat and decrease unit heat rate. Analysis of saving coal consumption and fans loading after and before modification has been carried out in this research paper.

Key Words: Air preheater, seal plate, radial sector plate, boiler efficiency

1. INTRODUCTION

Modern power plants generally use air preheater to increase thermal efficiency of boiler. Air pre heater is an important of boiler auxiliary, which primarily preheat the air for rapid and efficient combustion in the furnace. Air preheater typically accounts for over 10 % of boiler efficiency. If the cold air for combustion is not preheated, more fuel consumption will takes place which increase overall cost and decrease the efficiency of the plant. [1] The deterioration of air preheats performance as more leakage and basket fouling or plugging. The tri-sector module is passing section into the flue gas 180°, primary air 72° and secondary air 108° out of 360° angle of air preheater. [3]

3. SEALING SYSTEM

It is an implied requirement that the rotating parts should have some working clearance between their static parts to avoid any interference between them. Rotor is constructed to have high clearance to take care of their thermal expansion and these gaps are closed by flexible seals. These seals are classified into the following three major types [2]

- Radial seals
- Axial seals
- Bypass seals

Seals clearance take after adjust axial seal plate and radial sector plate shown in the below the table
### Table 1: Seals Clearance [4]

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Seals State</th>
<th>APHA Clearance</th>
<th>APHB Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radial Seal</td>
<td>Hot End Inboard: 0.2 mm</td>
<td>Hot End Outboard: 0.4 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cold End Inboard: 0.5 mm</td>
<td>Cold End Outboard: 13 mm</td>
</tr>
<tr>
<td>2</td>
<td>Axial Seal</td>
<td>Hot End: 7.7 mm</td>
<td>Cold End: 4.4 mm</td>
</tr>
<tr>
<td>3</td>
<td>Bypass Seal</td>
<td>Hot End: 4.1 mm</td>
<td>Cold End: 1.1 mm</td>
</tr>
</tbody>
</table>

### 4. PROFIT GAINED AFTER MODIFICATION

Air preheater is modified then after saving of cost calculates as coal consumption and fans loading.

#### Table 2: Fans Current and Parameters [4]

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Parameters</th>
<th>Before Modification</th>
<th>After Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fan A</td>
<td>Fan B</td>
</tr>
<tr>
<td>1</td>
<td>Unit Load</td>
<td>250 MW</td>
<td>250 MW</td>
</tr>
<tr>
<td>2</td>
<td>Fuel Consumption</td>
<td>148 T/Hr</td>
<td>146 T/Hr</td>
</tr>
<tr>
<td>3</td>
<td>PA Fan Current</td>
<td>82 Amp.</td>
<td>81 Amp.</td>
</tr>
<tr>
<td>4</td>
<td>FD Fan Current</td>
<td>31 Amp.</td>
<td>33 Amp.</td>
</tr>
<tr>
<td>5</td>
<td>ID Fan Current</td>
<td>170 Amp.</td>
<td>172 Amp.</td>
</tr>
</tbody>
</table>

#### 4.1 Air leakage

The method determines air pre-heater as per this procedure is the volumetric method. This is an empirical approximation of air pre-heaters leakage.

Oxygen in air preheater \( (O_2) = 3.2 \)

Oxygen leaves air preheater \( (O_2) = 5.3 \)

\[
AL = \frac{(O_2 g_i - O_2 g_e)}{(21 - O_2 g)} \times 0.9 \times 100
\]

\[
AL = \frac{5.3 - 3.2}{21 - 5.3} \times 0.9 \times 100
\]

\[= 12.03\%
\]

#### 4.2 Coal cost saving per hour

Coal consumption before modification \( = 148 \text{T/Hr.} \)

Coal consumption after modification \( = 146 \text{T/Hr.} \)

Coal consumption saving per hour \( = 148 - 146 = 2 \text{T/Hr.} \)

Coal cost per hour \( = 4000 \times 2 \)

Cost of coal saving per year \( = 8000 \times 24 \times 365 \)

\[= \text{Rs 7008000/-} \]

#### 4.3 Cost Benefit due to fan loading (Current)

Total fans current before modification \( = 569 \text{Amp} \)

Total fans current after modification \( = 511 \text{Amp} \)

Total saving fans current \( = 58 \text{Amp} \)

Power \( = 1.732 \times VI \times \cos\Phi \)

Power saved \( = 1.732 \times (6.6 \text{K}) \times 58 \times 0.86 \)

\[= 570.18 \text{KW} \]

Energy saved per year \( = 570.18 \times 24 \times 365 \)

\[= 4994846.88 \text{KWHr} \]

Energy cost per unit \( = \text{Rs 2.60} \)

Energy cost saving per year \( = 4994846.88 \times 2.60 \)

\[= \text{Rs 12986601.88} \]

#### 4.4 Total cost saving per year

\[= \text{Rs 12986601.88 + 7008000} \]

\[= \text{Rs 83066607.72/-} \]

#### 5. CONCLUSION

The air preheater are important of boiler auxiliary. The air preheater improves performance of the plant due to more heat transfer to incoming cold air for combustion. Cleaning of plugging or fouling reduce power consumption, unit heat rate and coal consumption. Overall performance and profit of power plant hence increase.

#### REFERENCES

of Mechanical Engineering and Technology (IJMET) volume 5, issue 9 September 2014

[2] Fans and air heaters, national power training institute, Ministry of power, Govt. of India, Reprint December 2012


[4] Operation and Maintenance manual of Chhabra thermal power plant and sites