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PERFORMANCE ANALYSIS AND ENERGY AUDIT ON BOILER LOSSES IN THERMAL POWER PLANT

[1] Asish kumar sahoo, [1]A. Behera, [1]Tanisha Ipsita Hota, [1]P. Das, [1]G. Barik
[1]Asst. Professor, Department of Mechanical Engineering, GITAM, Bhubaneswar

Abstract:

Energy audit involves studying energy consumption processes to find better paths for energy saving. For this study, Kottagudem Thermal Power Station, Stage VII-1 X 800 MW Coal-based thermal power plant, a supercritical boiler, was selected. In this project, an energy audit was conducted on a boiler to identify various losses. One such loss is heat loss due to dry flue gas, which acts as a barrier to heat transfer in the economizer section, located in the boiler's second pass. This loss prevents proper preheating of water, potentially affecting both boiler efficiency and fuel consumption. Various parameters were measured in this study, including coal consumption, steam pressure, coal calorific value, flue gas temperature, and proximate analysis of coal. The primary objective was to reduce heat loss due to dry flue gases by modifying the existing system of steam-based soot blowers. Currently, steam is used as the working medium to clean the flue gases surrounding the economizer coils. However, this method is insufficient in reducing heat loss and is costly. Therefore, modification in both the working medium and the machine (soot blower) is necessary. In this modification, the medium is changed from steam to hot air to efficiently clean the flue gases in the economizer coils and improve heat transfer rates. Additionally, the soot blower lance and speed are upgraded. Now that air is the medium, which is cheap and readily available, there is no need to use steam. This change saves energy and coal, impacting both boiler and overall plant efficiency. However, this process may not be economical for existing power plants due to significant changes required in the boiler section. Therefore, it is highly recommended for upcoming thermal power plants

Keywords: Thermal Power Plant, Energy Audit, Boiler Efficiency, Soot Blowers, Heat Losses.

1. Introduction:

In India, electricity generation is primarily derived from two main categories: conventional and non-conventional sources. Conventional sources include thermal (such as coal, lignite, natural gas, and oil), hydro, and nuclear power. On the other hand, non-conventional sources, also known as renewable energy sources, include solar, wind, agricultural, and domestic waste, among others.

India heavily relies on fossil fuels for its energy needs, with approximately 60% of its energy generation capacity coming from sources like coal, crude oil, and natural gas. Coal consumption alone accounts for 48.8% of India's total energy consumption, followed by crude oil at 24% and natural gas at 6%. To meet its energy demands, India heavily depends on importing fossil fuels, which are projected to exceed 53% of the country's total energy consumption. In 2009-10, India imported 159.26 million tons of crude oil, which amounted to 80% of its domestic consumption, and these oil imports constituted 31% of the country's total imports. The demand for electricity in India faces challenges due to domestic coal shortages, leading to an 18% increase in coal imports for electricity generation in 2010. Despite these challenges, India's energy market is one of the world's fastest-growing, driven by rapid economic expansion. It is expected to be the second-largest contributor to the global increase in energy demand by 2035. However, India's limited domestic fossil fuel reserves necessitate a shift towards renewable energy sources and nuclear power.

India has ambitious plans to expand its renewable energy capacity, aiming to add approximately 20GW of solar power and increase the contribution of nuclear power to overall electricity generation capacity from 4.2% to 9%. Currently, the country has five nuclear reactors under construction, ranking third globally in electricity generation from nuclear power. India plans to construct 18 additional nuclear reactors by 2025, with the goal of becoming the second-highest generator of nuclear electricity worldwide.The performance of boilers, crucial for energy generation, deteriorates over time due to factors like poor combustion, heat transfer fouling, and inadequate operation and maintenance. Additionally, the deterioration of fuel quality and water quality can lead to decreased boiler performance. Efficiency testing is essential to evaluate the current level of boiler efficiency and identify any deviations from optimal efficiency, enabling corrective action to conserve energy in industries

2. THE OBJECTIVE OF CONDUCTING A PERFORMANCE TEST:

1. Evaluating Boiler Efficiency: This process entails assessing how efficiently the boiler transforms fuel into usable energy.
2. Calculating the Evaporation Ratio: This metric helps determine the quantity of steam produced per unit of fuel utilized, offering a measure of the boiler's operational efficiency.

Conducting a performance test is essential for comprehending the actual functionality and effectiveness of the boiler, enabling comparisons against design specifications or industry benchmarks. It facilitates the monitoring of fluctuations in boiler efficiency over time, aiding in the identification of potential opportunities for energy efficiency improvements.

3. Boiler efficiency can typically be evaluated through two primary approaches:

1. Direct Methodology: This method entails directly comparing the energy extracted by the working fluid (consisting of water and steam) with the energy content of the boiler fuel.
2. Indirect Methodology: In this approach, efficiency is determined by analysing the disparity between losses incurred during boiler operation and the energy input supplied.

By utilizing these methodologies, stakeholders can acquire valuable insights into the operational efficiency of the boiler, thereby guiding decisions aimed at optimizing energy utilization and enhancing overall performance.

4. LOSS OF HEAT CALCULATIONS:

4.1 DIRECT METHOD

To determine boiler efficiency, the direct method is often preferred due to its simplicity in calculations and the readily available data provided by instruments.

Type of Boiler under test: Coal fired Boiler. Heat output data:

Quantity of steam generated (output): 1815 TPH. Steam pressure / temperature: 186.52 Bar.

Enthalpy of steam (dry & Saturated) at 10 kg/cm2 (g) pressure: 868.64 Cal/kg Feed water temperature: 277.60 C

Enthalpy of feed water: 291.41 Cal/kg

Heat input data:

Quantity of coal consumed (Input): 320TPH. GCV of coal: 3682 k Cal/kg

Where **Q** = Quantity of steam generated per hour (kg/hr.) q = Quantity of fuel used per hour (kg/hr.)

GCV = Gross calorific value of the fuel (Cal/kg)

H = Enthalpy of steam (Cal/kg)

h = Enthalpy of feed water (Cal/kg)

Boiler Efficiency (η) = **Q×(H−h) q×GCV of Coal**×

= **1815000**× (**868**.**64**−**291**.**41**)**0**×**3682**×**100**

=**89**.**17**%

4.2 Indirect Method:

To calculate boiler efficiency using the indirect method, data on various losses incurred during boiler operation are required, including those mentioned above. Without specific data for the KTPS VII Stage 1×800 MW Thermal Power Plant in Kottagudem, Telangana State, accurate calculation of boiler efficiency by the indirect method is not feasible.

PARAMETERS OF 800MW BOILER

Fuel Firing Rate = 231450 kg/hr.
Steam Generation rate = 1625000 kg/hr. Steam Pressure = 175.49 bar
Steam Temperature = 540°C Feed Water Temp = 255°C
%$CO2 in\ Flue\ Gas$ =14%
% CO in Flue Gas=0.55 %

ANALYSIS OF FUEL:

Ash in Fuel = 36% Moisture in Coal = 9% Carbon Content = 46% Hydrogen Content = 2.70% Sulphur Content = 0.50% Oxygen Content = 6.2%

BOILER EFFICIENCY BY INDIRECT METHOD:

Theoretical air requirement

=[$(\mathbf{11.6}\times\mathbf{C})$+{$\mathbf{34.8}(\mathbf{H2}-\mathbf{O28})$}+$(\mathbf{0.45}\times\mathbf{S})\mathbf{100}$ Kg/Kg of coal
=[$(\mathbf{11.6}\times\mathbf{43})$+{$\mathbf{34.8}(\mathbf{2.70}-\mathbf{5.88})$}+$(\mathbf{0.45}\times\mathbf{0.48})\mathbf{100}$ Kg/Kg of coal
= 5.67%

Find Theoretical CO2

(CO2%) t= Moles of C Moles of N2+Moles of C
Where Moles of N2 = Wt. of N2 in theoretical air Mole Wt of N2 +Wt of N2 in Fuel Mole Wt. of N2
=6.027×7710028+0.014928 =0.166227
Where Moles of C = 0.4612 =0.03833 heoretical CO2%=0.038330.16627+0.03833
= 18.73%

Fixed Air Supplied: -

Actual CO2 measured in flue gas =14.2%
% Excess Air Supplied EA = 7900[(CO2%) t −(CO2%) a] (CO2%) a×[100−(CO2%) t]
=7900[18.73−14]14.2[100−18.73]
= 32.842%

ACTUAL MASS OF AIR SUPPLIED

Actual mass of air supplied/ kg of fuel (AAS) = {1 +EA100} ×theoretical air
= {1+32.84100} ×6.027
= 8.0063 kg/ kg of coal

ACTUAL MASS OF DRY FLUE GAS

Mass of dry flue gas = Mass of CO2+ Mass of N2 Content in Fuel + Mass of N2 in combustion Air Supplied +Mass of Oxygen in Flue Gas
= 0.4165×4412+0.016+7.13×77100+(7.13−4.91) ×23100
= 7.543 kg/kg of coal

CALCULATIONS FOR LOSSES OF BOILER (**Without Soot Blower**):

Without soot blower the average flue gas temperature = 220ºC Ambient Temperature = 35.54 ºC

1. % LOSS OF HEAT DUE TO DRY FLUE GAS: -

(L1%) = m × Cp×(T_f−T_a) x GCV Of Fuel×100
=6.083×0.23× (220−35.54)3682×100
= 7.0091%

2. % LOSS OF HEAT DUE TO EVAPORATION OF WATER FORMED DUE TO H2 IN FUEL: -

L2=9×H2×{584+Cp×(T_f−T_a)} x GVC of Fuel×100 L2=9×0.027× {584+0.45× (220−35.54)}3682×100
= 4.40%

3. % LOSS OF HEAT DUE TO MOISTURE PRESENT IN FUEL: -

L3=M×{584+Cp×(T_f−T_a)} GCV of Fuel×100 L3=0.09× {584+0.45× (220−35.54)}3682×100
= 1.630%

4. %LOSS OF HEAT DUE TO MOISTURE PRESENT IN AIR:-

L4=AAS×Humidity Factor×Cp×(T_f−T_a)GCV Of Fuel×100 L4=8×0.0204×0.45×(220−35.54)3682×100

= 0.3679%

5. LOSS OF HEAT DUE TO INCOMPLETE COMBUSTION: L5=%CO×C%CO+%CO2×5744GCV of Fuel×100 L5=0.55×0.400.55+14×57443682×100

= 2.35%

6. LOSS OF HEAT DUE TO RADIATION AND CONVECTION:

L6=0.548 x [(Ts / 55.55)4 – (Ta / 55.55)4] + 1.957 x (Ts – Ta) 1.25 x sq.rt of [(196.85 Vm + 68.9) / 68.9]

= 0.48 %

7. LOSS OF HEAT DUE TO UN BURNT IN FLY ASH (%):

%L7=(Total ash collected/kg of fuel burnt)×GCV of Fly Ash)GCV Of Fuel×100

% Ash in Coal = 34% Ratio = 50:10

GCV of Fly Ash = 452.5 kcal/kg Amount of Fly Ash = 0.1×0.34

= 0.034

Loss of Heat in Fly Ash = 0.034×452.5

= 15.385

%*L*7=15.3853682×100

= 0.4178%

8. LOSS OF HEAT DUE TO UN BURNT IN BOTTOM ASH (%): L8=(Total Ash Collected /Kg of Fuel Burnt)×GCV Of Bottom Ash GCV Of Fuel×100 GCV of Bottom Ash = 800 k Cal/kg

Amount of bottom ash in kg of coal = 0.5×0.34

= 0.17

Loss of Heat in Bottom Ash = 0.17×800

= 136

%*L*8=1363682×100

= 3.69%

Based on the provided data, the total losses for the boiler are calculated as follows: Total Losses = Loss-1 + Loss-2 + Loss-3 + Loss-4 + Loss-5 + Loss-6 + Loss-7 + Loss-8

= (7.0091 + 4.40 + 1.630 + 0.3679 + 2.35 + 0.48 + 0.442 + 3.91) %

= 20.58%

Hence, the boiler efficiency via the indirect method (excluding the use of a soot blower) can be calculated as follows:

Efficiency of Boiler = 100 - % Total Losses

= 100 - 20.58%

≈ 79.41%

Thus, based on the provided data, the boiler efficiency using the indirect method (without the utilization of a soot blower) is estimated to be around 79.41%.

5. Soot Blower:

The facility is equipped with three types of soot blowers: 88 Water Wall Soot Blowers (WWSBs), 44 Long Retractable Soot Blowers (LRSBs), and 2 Air Heaters Soot Blowers (AHSBs). Among the 88 WWSBs, 22 are located below the Wind box, while the remaining 66 are distributed across three elevations above the Wind box.

Steam required for soot blowing is supplied from the outlet header of Divisional Palette, operating at a pressure of 25KSc and within a temperature range of 250-300°C. Pressure regulation to 25Kg/Cm^2 is maintained via a control valve, and all drain valves are kept open until the steam temperature exceeds 250°C. Additionally, a safety valve is installed in the line with an appropriate setting. Drain lines, comprising four from WWSBs, two from LRSBs, and two from AHSBs, are connected to the IBD flash tank (IBDFT).

Information gleaned from Kotthagudem Thermal Power Plant VI Stage 1×800 MW indicates a preference for adopting the latest type of soot blowers to augment boiler efficiency, surpassing the capabilities of the current equipment.

Fig. 1 Soot Blower

5.1 Boiler Efficiency Calculation Using the Indirect Method (Incorporating Soot Blowers):

With soot blower the average flue gas temperature = 180ºC Ambient Temperature = 35.54 ºC

Blowing Medium = Steam

1. % LOSS OF HEAT DUE TO DRY FLUE GAS: -

(L1%) = m × Cp×(T_f−T_a) x GCV Of Fuel×100

=6.083×0.23×(180−35.54)3682×100

= 5.489%

2. % LOSS OF HEAT DUE TO EVAPORATION OF WATER FORMED DUE TO H2 IN FUEL: -

L2=9×H2×{584+Cp×(T_f−T_a)} x GVC of Fuel×100 L2=9×0.027×{584+0.45×(180−35.54)}3682×100

= 4.28%

3. % LOSS OF HEAT DUE TO MOISTURE PRESENT IN FUEL: - L3=M×{584+Cp×(T_f−T_a)}GCV of Fuel×100 L3=0.09×{584+0.45×(180−35.54)}3682×100

= 1.586%

4. %LOSS OF HEAT DUE TO MOISTURE PRESENT IN AIR: -

L4=**AAS**×**Humidity Factor**×**Cp**×(**T_f**−**T_a**) **GCV Of Fuel**×**100**

L4=8×0.0204×0.45× (180−35.54)3682×100

= 0.288%

5. LOSS OF HEAT DUE TO INCOMPLETE COMBUSTION:

L5=%**CO**×**C**%**CO**+%**CO2**×**5744** x **GCV of Fuel**×100 L5=0.55×0.400.55+14×57443682×100

= 2.35%

6. LOSS OF HEAT DUE TO RADIATION AND CONVECTION:

L6=0.548 x [(Ts / 55.55)4 – (Ta / 55.55)4] + 1.957 x (Ts – Ta) 1.25 x sq.rt of [(196.85 Vm + 68.9) / 68.9]

= 0.46 %

7. LOSS OF HEAT DUE TO UN BURNT IN FLY ASH (%):

%**L7**=(**Total ash collecetd/kg offuel burnt**)×**GCVof Fly Ash**)**GCV Of Fuel**×**100**

% Ash in Coal = 34% Ratio = 50:10

GCV of Fly Ash = 452.5 kcal/kg Amount of Fly Ash = 0.1×0.34

= 0.034

Loss of Heat in Fly Ash = 0.034×452.5

= 15.385

%L7=15.383682×100

= 0.4178%

8. LOSS OF HEATDUE TO UN BURNT IN BOTTOM ASH (%):

L8=(**Total Ash Collected /Kg of Fuel Burnt**)×**GCV Of Bottom AshGCV Of Fuel**×**100**

GCV of Bottom Ash = 800 k Cal/kg

Amount of bottom ash in kg of coal = 0.5×0.34

= 0.17

Loss of Heat in Bottom Ash = 0.17×800

= 136

%*L*8=1363682×100

= 3.69%

S.NO	**LOSSES**	**% of LOSS**
1	LOSS-1	5.489
2	LOSS-2	4.286
3	LOSS-3	1.586
4	LOSS-4	0.288

5	LOSS-5	2.35
6	LOSS-6	0.46
7	LOSS-7	0.4178
8	LOSS-8	3.69

Total Losses Total Losses =L1+L2+L3+L4+L5+L6+L7+L8
= (5.489+4.286+1.586+0.288+2.35+0.46+0.4424+3.91) %
= 18.814%

Efficiency of Boiler by Indirect Method (without soot blower) =(% **Total Losses**)
=100−(18.58%)
= 81.18%

5.2 Boiler Efficiency Calculation Using the Indirect Method (Incorporating Modern Soot Blowers):

A lengthy extendable soot blower is employed to eliminate ash deposits across various sections of the boiler, such as the superheater, reheater, and economizer zones. Upon activation, the soot blower's lance tube and nozzle head extend and rotate within the boiler flue to dislodge ash accumulations on the heating surfaces, covering an effective blowing radius ranging from 2 to 2.5 meters. These soot blowers are engineered to endure flue gas temperatures of up to 1300℃. Following the soot blowing process, the lance tube retracts to prevent damage from the high-temperature flue gas.
In boiler operations, the buildup of soot and coking on heating surfaces is a prevalent issue, underscoring the necessity of installing a soot blower in power plants. Currently, steam soot blowers and sonic soot blowers

constitute the two primary types found in power station boilers, with steam soot blowers being the most prevalent and efficient choice.These specifications are pivotal for integrating modern soot blowers into the indirect method calculation used to determine boiler efficiency.

Fig. 2 Modern Soot Blower

Specification of Soot blower:
Soot blowing medium: Hot Air
Application field: Convection heating surfaces of boiler superheater, reheater, economizer Valve material: Chromium-Molybdenum steel (Cr-Mo steel)
Maximum gas temperature: 500℃ Blowing time: 45-745 seconds
Blowing tube material: Chromium-Molybdenum steel or specialized steel suitable for boiler operating conditions
Steam consumption: 30-100 kilograms per minute. Travel distance: 0.3-11 meters
Total weight: 200-770 kilograms

Blowing angle: 0°-360°
Effective blowing radius: 0.5-4.5 meters
Recommended blowing pressure: 0.8-1.5 Megapascals (Mpa) Total weight: 200-1300 kilograms

Design Features:
Drive System: The forward rotary movement of the lance is facilitated by a stationary motor and gearbox

arrangement, employing a robust roller chain to drive an ACME lead screw and drive nut.

Blowing Action: The design of the soot blower allows it to cover distances ranging from 0.5 to 2.5 meters, featuring a generously sized feed tube that optimizes steam flow towards the convergent- divergent nozzles. These nozzles execute cleaning maneuvers in a helical pattern during both the forward and reverse strokes.

Emergency Manual Operation: In the event of a power failure, manual operation of the soot blower becomes possible using a provided crank handle. This crank securely attaches to the reduction gearbox/motor assembly on the blower casing, ensuring a safe and convenient manual operation.

Manual Maintenance: Key components, such as the main gear, are supported by self-lubricating phosphor bronze bearings, facilitating easy adjustment of the feed tube and valve steam packing through the maintenance access cover.

Simple Installation: For shorter stroke soot blowers, a cantilever support design option is available, eliminating the need for rear support structures. Mounting the blower directly onto the heater casing via a fabricated wall box with a sealed connection can significantly reduce the costs typically associated with constructing rear support structures.

Loss of Heat Calculations for Modern Soot Blower: Considering a modern soot blower, the average flue gas temperature is set at 140ºC, with an ambient temperature of 35.74 ºC. Air serves as the blowing medium in this configuration

1. % LOSS OF HEATDUE TO DRY FLUE GAS: -

(L1%) = m×Cp×(T_f−T_a)GCV Of Fuel×100

=6.083×0.23×(140−35.74)/3682×100

= 3.93%

2. % LOSS OF HEATDUE TO EVAPORATION OF WATER FORMED DUE TO H2 IN FUEL: -

L2=9×H2×{584+Cp×(T_f−T_a)}GVC of Fuel×100 L2=9×0.027×{584+0.45×(140−35.74)}/3682×100

= 4.14%

3. % LOSS OF HEATDUE TO MOISTURE PRESENT IN FUEL: - L3=M×{584+Cp×(T_f−T_a)}GCV of Fuel×100 L3=0.09×{584+0.45×(140−35.74)}/3682×100

= 1.543%

4. %LOSS OF HEATDUE TO MOISTURE PRESENT IN AIR: -

L4=AAS × Humidity Factor ×Cp×(T_f−T_a)GCV Of Fuel×100 L4=8×0.0204×0.45×(140−35.74)/3682×100

= 0.20%

5. LOSS OF HEATDUE TO INCOMPLETE COMBUSTION: L5=%CO×C%CO+%CO2×5744GCV of Fuel×100 L5=0.55×0.40/0.55+14×5744/3682×100

= 2.35%

6. LOSS OF HEATDUE TO RADIATION AND CONVECTION:

L6=0.548 x [(Ts / 55.55)4 – (Ta / 55.55)4] + 1.957 x (Ts – Ta) 1.25 x sq.rt of [(196.85 Vm + 68.9) / 68.9]

= 0.42%

7. LOSS OF HEAT DUE TO UN BURNT IN FLY ASH (%):

%L7= (Total ash collected/kg of fuel burnt) ×GCV of Fly Ash) GCV Of Fuel×100

% Ash in Coal = 34% Ratio = 50:10

GCV of Fly Ash = 452.5 kcal/kg Amount of Fly Ash = 0.1×0.34

= 0.034

Loss of Heat in Fly Ash = 0.034×452.5

= 15.385

%L7=15.385/3682×100

= 0.41%

8. LOSS OF HEATDUE TO UN BURNT IN BOTTOM ASH (%):

L8=(**Total Ash Collected /Kg of Fuel Burnt**)×**GCV Of Bottom Ash GCV Of Fuel×100**

GCV of Bottom Ash = 800 k Cal/kg

Amount of bottom ash in kg of coal = 0.5×0.34

= 0.17

Loss of Heat in Bottom Ash = 0.17×800

= 136

%L8=136/3682×100

= 3.69%

S.NO	Losses	% of Loss
1	Loss-1	3.93
2	Loss-2	4.14
3	Loss-3	1.54
4	Loss-4	0.20
5	Loss-5	2.35
6	Loss-6	0.42
7	Loss-7	0.41
8	Loss-8	3.69

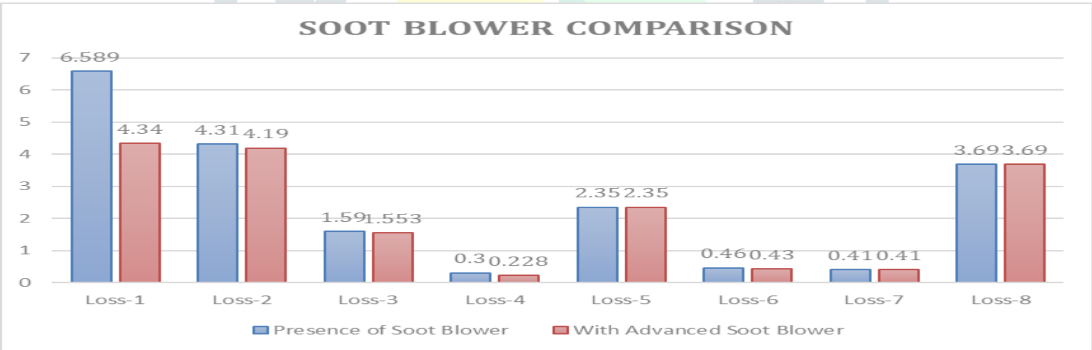
Total Losses Total Losses =L1+L2+L3+L4+L5+L6+L7+L8
= (3.93+4.14+1.54+0.20+2.35+0.43+0.41+3.69) %
= 16.19%
Efficiency of Boiler by Indirect Method (with modern soot blowers) =100−(% Total Losses)
=100−(16.19%)
= 83.81%

6. RESULTS & DISCUSSION

Graphical Comparisons:

From the calculations graphs are plotted between all variable losses considering soot blower and without soot blower. The obtained differences are observed in the graph below. From these graphs main observations are listed in the table

Losses	Presence of Soot Blower	Modern Soot Blower
Loss-1	6.589	4.34
Loss-2	4.31	4.19
Loss-3	1.59	1.53
Loss-4	0.30	0.228
Loss-5	2.35	2.35
Loss-6	0.46	0.43
Loss-7	0.41	0.41
Loss-8	3.69	3.69

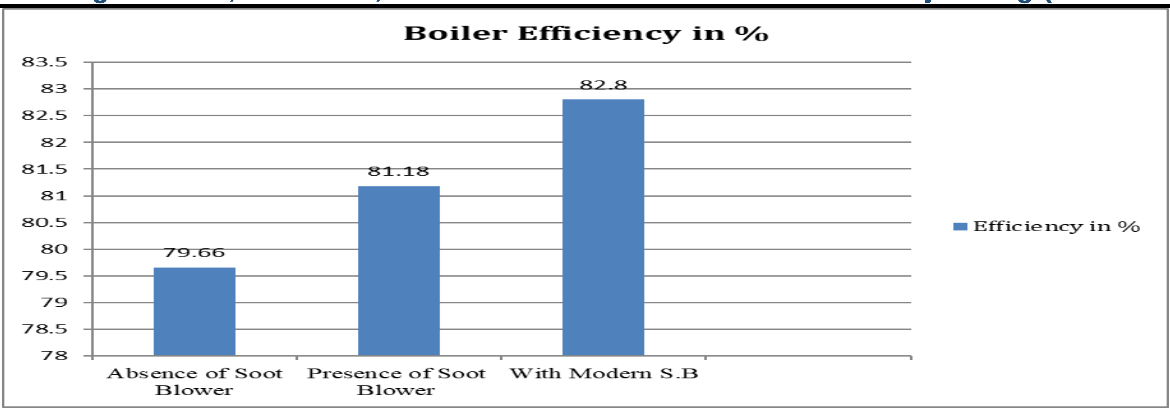


Graph. 1 Differenced in various heat losses considering with soot blower and modern soot blower. The graph depicts various efficiencies, including Efficiency without a soot blower, Efficiency with a soot blower, and Efficiency with a modern soot blower. The main observations derived from these graphs are catalogued in

Table for reference.

Type of Blower	Efficiency of Boiler
Absence of soot blower	79.16%
Presence of soot blower	81.18%
With Modern Soot Blower	82.80%

Efficiency comparison for Absence of soot blower, with presence of soot blower and modern soot blower.

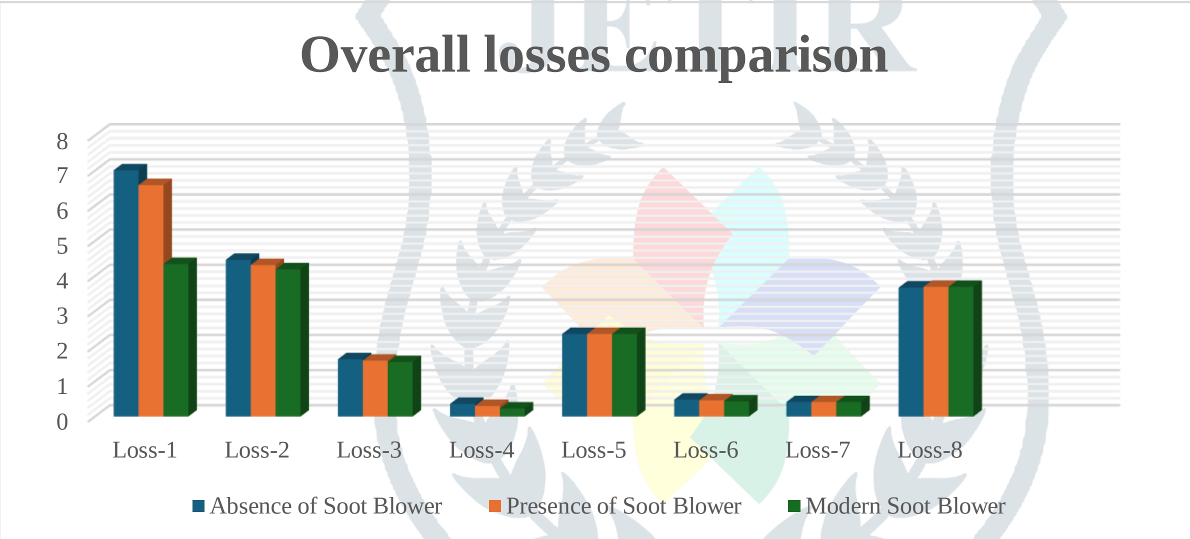


Graph: 2 Boiler Efficiency Comparison

The graph illustrates the plotted data regarding over losses under different conditions, namely without a soot blower, with a soot blower, and with a modern soot blower. The main observations derived from these graphs are summarized in Table 5.4 for further analysis and reference.

Type	Loss 1	Loss 2	Loss 3	Loss 4	Loss 5	Loss 6	Loss 7	Loss 8
Absence of Soot blower	7.0091	4.46	1.63	0.36	2.35	0.48	0.41	3.69
Presence of soot blower	6.589	4.31	1.59	0.30	2.35	0.46	0.41	3.69
Modern soot blower	4.34	4.19	1.553	0.228	2.35	0.43	0.41	3.69

All the losses with various types of soot blowers are discussed.



Graph: 3 Overall, Losses Comparison Graph

In the above all graphs unburnt losses in bottom ash and fly ash are not changed because of improper combustion this is due to low GCV of Fuel i.e. Coal once we will use high GCV of Coal these losses also reduced so we use Semi bituminous coal but it is costly. present here we use Indian Ignite coal of F grade the GCV of this coal is 3682 k Cal/kg so % ash in coal is 34%. But in semi bituminous coal GCV is 5800 k al/kg. So %ash in coal is 12.1%.

7. CONCLUSION

Boiler efficiency is influenced by several factors, with heat losses being particularly crucial. One of the main contributors to reduced boiler efficiency is heat loss due to dry flue gas. This loss occurs because thick layers of soot inhibit heat transfer between the water inside the economizer coil and the flue gases This study aims to improve heat transfer rates by effectively removing soot from the coils using a low-cost method involving modified soot blowers. These modified blowers are designed to enhance motor power and adjust lance length, ensuring thorough coverage of all coils for effective soot removal

Currently, the plant's existing soot blowers, which use steam, are inefficient, leading to ineffective cleaning of the coils and impacting boiler efficiency. By modifying these blowers to utilize air as a medium, the need for steam is eliminated, making the process cost-free. This approach ensures that boiler output remains unaffected while efficiently cleaning the coils.Consequently, the projected reduction in loss due to dry flue gas is significant, up to 3.93%, resulting in an enhanced boiler efficiency of up to 83.81%

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