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Design and Analysis of Actual Soot Cleaning System for Fire Tube Boiler

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Abstract – Soot blowers are used to control a boiler with high power to release dirt from the heat transfer surfaces towards the gas. They are additionally accustomed to gas pass closure. They are mechanical devices used to clean gas side boiler ash and deposits online on a periodic basis. They dictate To get rid of the ash deposited on the coil and improve the heat transfer power, the operating medium through the nozzle against the soot or ash deposited on the heat transfer surfaces on the boiler. Sort the blowers in boilers in many places such as water walls, super heaters, economists and air preheaters. Watch for heat transfer soot blowers and efficiencies do not improve. Therefore, the design and analysis of soot burners can effectively increase boiler power in power plants.
Keywords: Boiler, Soot blowers, Super heater, Re-heater, Economizer etc.

I. INTRODUCTION

Despite differences in areas such as the need for cleaning coverage and the severity of deposit accumulation, soot blowing boilers have associate degree acts.
Mainly suit blowers consist of
A tube component, which is inserted into the boiler and contains the cleaning medium.
The nozzle at the tip of La Lance increases the speed of steam flow and maintains position
Cleaning medium. & A system for rotating the tube element and
A Management Unit.
The operating medium for sat blowers is saturated steam, superheated steam, compressed gas or water. In most cases, the hand-selected steam area becomes superhit as the unit operating area, indicating that wetting in saturated steam will cause erosion of the tube surfaces. In addition, superheat steam, when combined with saturated steam, has a large cleaning capacity due to the upward speed of sound through the saw blower nozzle, as shown in Figure 1.

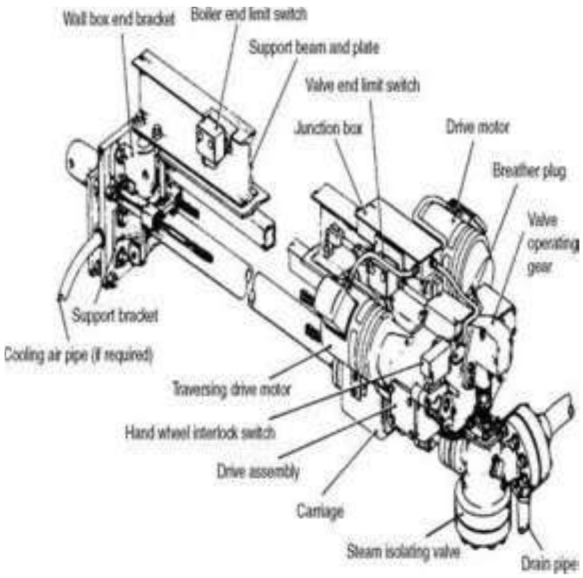


Fig1. Soot Blower

The specific styles of soot burners used in boilers are as follows:
- Wall blowers

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- Long-lasting retractable Soot blowers
- Half-folding Soot blowers
- Air pre-heater Soot blowers

Wall blowers are used to clean the furnace wall near the boiler near the coal burner. The operating medium for Soot blowers is saturated steam, super-heat steam, compressed gas or water. In most cases super heat steam area unit hand-picking indicates that there is an erosion of the tube surface due to wetting in saturated steam as the operating medium.

II. PROBLEM IDENTIFICATION

In this project we have observed that the workers are suffering from fatigue and harmful emissions from soot so we are trying to decrease the time required for cleaning the boiler tube and increasing the overall boiler efficiency.

III. OBJECTIVES

This work consists of soot blower operation. The targets are

A. To make soot blower smooth the soot deposition at the boiler tube more successfully and increase the overall running overall performance of the boiler.
B. To design 4 tube structure of soot blower. Soot blowers are supplied in boilers in many places such as hot heaters, re-heaters, economizers and air pre-warmers.
C. To lessen harm on furnace wall tubes due to immoderate blowing
D. On line cleaning of localized regions is accomplished via soot blowers using high-pressure steam or air.
E. To reduce steam wastage.
F. In this undertaking proper and suitable scheduled time is mentioned.

IV. LITERATURE SURVEY

Gowshikan.M.et.al. Chemical Recovery Boiler uses black alcohol, which is in vain in the paper industry liquids come out of the pulp. One of the major components needed to clean a viewing blower Sediment is deposited on the boiler pipes which affects the heat transfer. Many problems such as steam leakage, lance Tube bending, ash deposition and corrosion on lance tubes are often reported between 28 soot blowers. SPB Limited has identified and analyzed the problems encountered in the indie project, soot blowers. There are problems Finished by converting the material from stainless steel (310) to magnesium alloy (AZ91D). Solution for Chemicals are given for corrosion, ash deposition and vapor leakage for proper functioning of soot blowers. Recovery Boiler.
Atmega.et.al. is the main equipment in the boiler thermal power plant. Gray on the surface Boiler pipes is still a major concern and affect the efficiency of coal-fired boilers. In the present tense Blowers are operated manually in each shift. This project is one of the embedded based industry Automation technique for efficient operation of suit blower in both auto and manual mode Adopts suit blower's stock-based temperature control for optimization of soot blower control the capacity of the boiler. The automation technique is used in real time using PROTEUS.

V. SOOT BLOWER WORKING PROCESS

Soot blower is a device that directs a flow or some of streams of cleansing medium on the ash deposits in order that they get dislodged by means of the impact of the jets. Referred to as the height effect pressure (PIP), it's miles the energy at a sure distance from the nozzle of the SBS. The PIP relies upon at the,
nozzle length and configuration
fluid stress and temperature
Soot blowers encompass four elements:
- Nozzles for blowing the fluid
- Detail (or lance in longer SBS) for conveying the fluid
- Power machine for rotating or advancing/retracting the element
- Manage system

Steam for soot blowing should be dry beneath all conditions to prevent impingement of heavy water debris that can render critical damage via way of erosion or puncture. Saturated steam enables to supply a high PIP. Preferably, there need to be 10- 20°c of superheat. Better superheat is also employed. The steam receives lighter however the jet speed increases, making the PIP better and resulting in a higher cleaning.

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To prevent blowing or nozzle pressure, the vapor pressure is first reduced in a poppet valve placed next to the lance to <5-25 barg (75-350 psig), depending on the actual configuration. Several stages of pressure reduction take place before the steam emerges at the prevailing draft inside the boiler setting. Steam from the nozzles is at supersonic velocity.

A poppet valve has an adjusting nut for varying the blowing pressure, and each SB is set for the best result depending on the type of ash deposits. Tenacious deposits need a higher pressure. For fluffy deposits, the pressure should be lowered to prevent tube damage. SBs are practically ineffective on any flowing low-viscosity slags, such as those found with oil firing, as there are no deposits to blow away. The drive motors can be either electric or pneumatic, with the latter used in refineries and similar areas with stringent requirements of fire protection. Before starting, the blower is in rest at its rear end position. The tube element is completely drawn off from the boiler and the nozzle will be outside the vertical tube walls of the boiler. When the motor is started, the tube element starts moving with rotational movement. At the same time, the carriage free up the rear limit switch as it moves forward on two track beam rails and projects the lance tube into the flue gas flow. Just when the nozzles allow inside the furnace gas flow path the trip pin on the carriage will be striking a cam and actuating the steam valve to open. Steam gets admitted through the nozzles and cleans the tubes around boilers.

The carriage continuously concentrated, until the nozzles reach the front- end position. The limit switch located at the frontend position and reverses the position of rotation of the motor. Due to the reverse rotation the blower now starts retracting. Before the nozzles reach the boiler wall, the blower valve closes and cut off the blowing. The rear-end limit switch cuts of the supply to the motor as soon as the lance tube comes to the original position.

VI. THERMAL POWER STATION-I EXPANSION

The soot blower's system was successful in providing regenerative air heaters with superheat steam to the boiler soot blower to clean the floor in place of the blower and blower re - suction duct to clean the air flow turbine to clean the soot blower. Steam is taken from extraordinary heater SH2 coil outlet header with a stress control station where the pressure is reduced to 24 bar. The temperature of the extraordinary-heated steam is approximate 4000c. Quantity of steam consumed per blower according to operation is 750kg. Overall performance of operation of is 5 minutes. General time ate up for one cycle is one hundred twenty mins. Each soot blower can cowl three-meter diameter and 50% of the furnace width.

The soot blower includes a tube detail with 2-venturi nozzles via that steam is blown on the tube bundles round the specific blower. The tube detail might be stepping into the flue gasoline flow, with a rotating motion and acquire back to its authentic function.

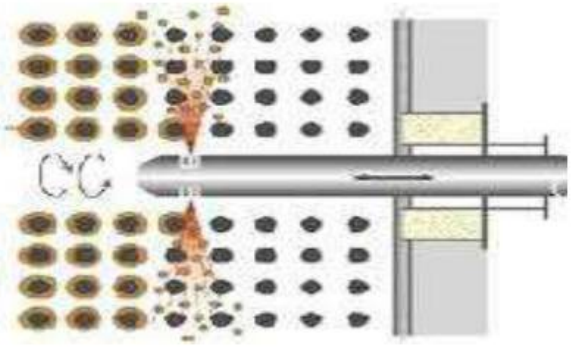


Fig-2: soot blower operation

Throughout this, the nozzles movements in a helical direction. The 2 nozzles adverse each different and the spreading blowing jets ensure entire cleaning insurance during the complete movement of the tubes.

VII. DESIGN CALCULATION

Before starting, the blower is in its final closing position. The tube element is completely away from the boiler and the nozzle is located outside the vertical tube walls of the boiler. When the motor is powered, the tube element begins to move with rotational motion. At the same time, it releases the rear limit switch as the car moves forward on the two-track beam train and projects the lance tube into the flue gas flow. When the nozzles allow the furnace inside the gas flow path, the travel pin on the car becomes a cam and activates to open the steam valve. Steam enters through the nozzle and cleans the pipes around the boilers, continuously running the cart until the nozzle reaches the front-end position. The limit switch is in the front position and reverses the rotating

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position of the motor. The blower now retracts due to reverse rotation. Before the nozzle reaches the boiler wall, the blower valve is closed and cut off by blowing. When the lance tube returns to its original position, the rear-end limit switch of the motor supply is cut off.

A. Pneumatic Actuator

$$F = p \cdot A = p \cdot \left(\frac{D^2 \cdot \pi}{4} - \frac{d^2 \cdot \pi}{4} \right) = 0{,}6 \left(\frac{N}{mm^2} \right) \cdot \left(\frac{40(mm)^2 \cdot 3{,}14}{4} - \frac{16(mm)^2 \cdot 3{,}14}{4} \right)$$

$$F = 0{,}6 \left(\frac{N}{mm^2} \right) \cdot 1055{,}04(mm^2) = 633{,}024\,N$$

B. DC Motor

$$P = \frac{2\,\pi\,N\,T}{60}$$

Where, P = Power = 100 Watt
N = Speed = 100 RPM
T = Torque = ?

$$100 = \frac{2 \text{ x } 3.14 \text{ x } 100 \text{ x } T}{60}$$

6000 = 628 x T
T = 9.55 NM/*Sec*

VIII. TEMPERATURE FOR ENTIRE COILS

Table-1: Temperature Entire coil Reading

Entire Coils	**Before Soot Blower**	**After Soot Blower**
Furnace Temperature Left [°C]	846	840
Downstream SH1 FG Temperature Left [°C]	810	781
Downstream SH3 FG Temperature Left [°C]	706	657
Downstream RH2 FG Temperature Left [°C]	593	551
Downstream SH2 FG Temperature Left [°C]	480	457
Downstream RH1 FG Temperature Left [°C]	399	382
FG Temperature Economizer 1st Left [°C]	351	337
FG Temperature Economizer 1st outlet Left	323	313

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[°C]		
RAPH Outlet Temperature [°C]	187	179.80
U2 Generated Load [kJ]	210	211.50
FG Temperature to Chimney [°C]	168.50	162.80
RAPH1 Inlet Air Temperature [°C]	34.70	34.80
RH Spray Water Flow [ton/hr]	17.80	17.94

Table-2: Fuel sample analysis

Constituent	**Units**	**Values**
Carbon	%	31.14
Hydrogen	%	3.326
Oxygen	%	9.38
Sulphur	%	0.7
Nitrogen	%	1.642
Moisture	%	53.60
Ash	%	4.77
GCV of Fuel	kJ/kg	11217.3
NCV of Fuel	kJ/kg	9468.3

IX. RESULTS AND DISCUSSION

Number of days	Total fuel saved
1st day	28.376ton/day
2nd day	14.18ton/day
3rd day	14.18ton/day
4th day	9.45ton/day

Performance of boiler using soot cleaning machine could be very important. Soot blowers are operated at 4 elevation in first elevation the soot blowers smooth SH1 and SH3 coils, right here slag is more in this vicinity and heat pick out-up growth after soot blower's operation straight away and slag formation starts within 2 days.

In RH2 and SH2 place slag formation is moderate the warmth switch remains clean for three-four days after soot blowing. Within the RH1 and econ location no slag formation is absorbed only discover accumulation is word this due to soot blower's operation, exhaust flue fuel temperature came down 6-7 degree centigrade. After soot blowing will increase the boiler performance via approximately zero.5% the advantage because of soot blower's operation at round 17 tone's /day for soot blower's operation we spent for slag disposing of reason.

X. ADVANTAGES OF SOOT BLOWER

A. According to the schedule as mentioned above and advantages of soot blower control, the boiler efficiency is increased by 5% to 10%.

B. The overall efficiency increases nearly 2% to3% by having soot blower with temperature controlled mode.

C. The effectiveness of cleaning around the superheaters, economizer.

D. Low operating and maintenance cost.

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XI. APPLICATIONS

A. Soot blowers are used in boilers for cleaning purpose.
B. Soot removes slag formation in textile industries, etc.
C. Blowers remove ash content in rap.

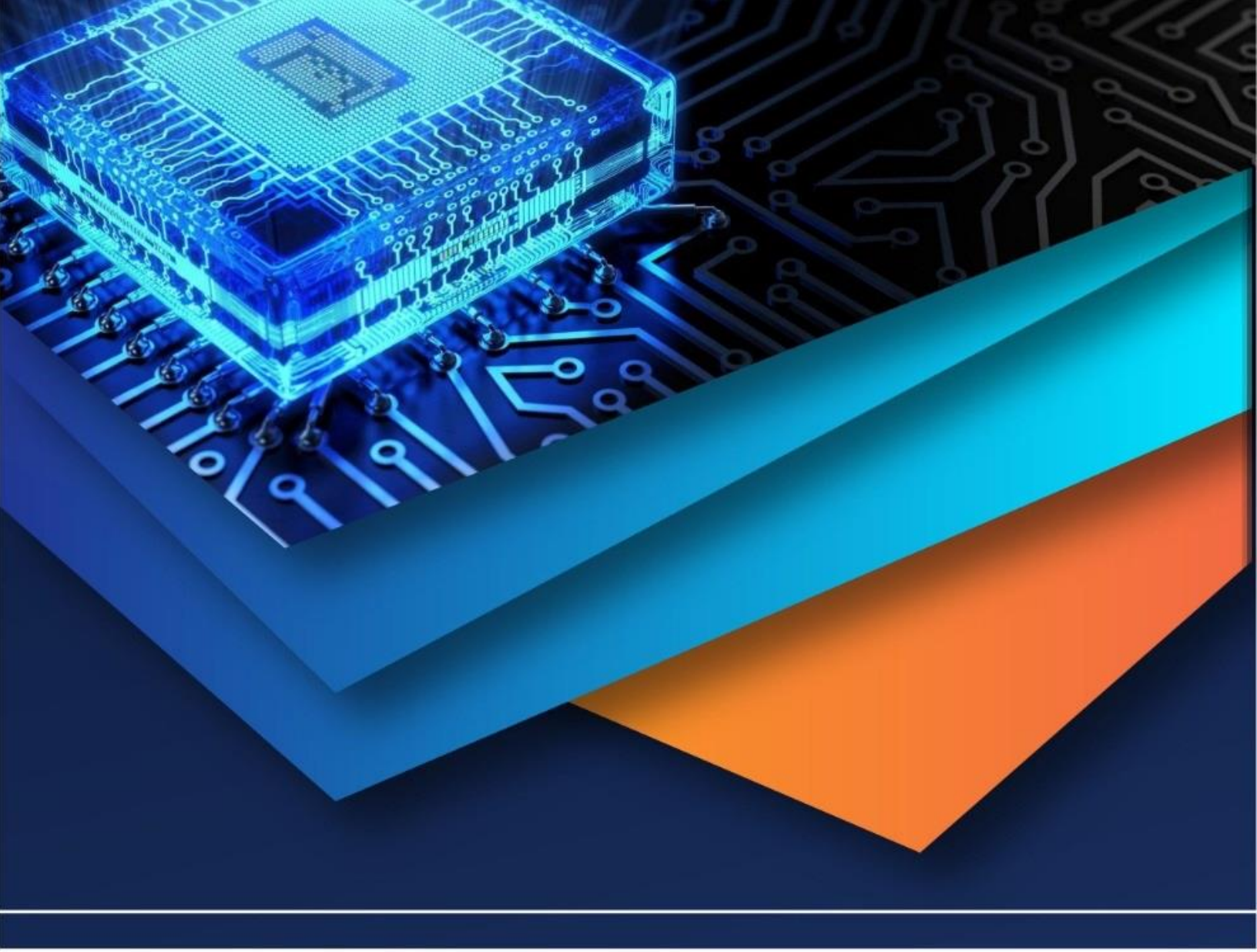
XII. CONCLUSION

Soot blower direct a running medium thru nozzle in opposition to the soot or ash accrued on the warmth transfer surfaces of boilers to dispose of ash deposited on coils, and enhance heat transfer efficiency. Soot blowers situated in boilers at numerous locations like water partitions, superheaters, economizers and air pre heaters. In boilers at the same time as not soot blowers the warmth switch won't as in keeping with the appearance and improve potency. Therefore, the observe of soot blowers can correctly boom the boiler efficiency in power plants.

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