IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 01-07

Effectiveness Of Sootblowers In Boilers Thermal Power Station

V.Arun[1],A.Arulkumar[2], B.Kavibalan[3],G.Nandhakumar[4],G.Paramaguru[5].
[1,2,3,4]UGStudents,Department of Mechanical Engineering,Surya Group Of Institutions ,Villupuram.
[5]Assisstant professor ,Department Of Mechanical Engineering, Surya Group Of Institution , Villupuram.

Abstract: *Soot blowers are used to free from the dirt gas side of heat transfer surfaces to permit the boiler to control at high potency. They additionally accustomed stop plugging of the gas passes. They're mechanical devices used for on-line cleanup of gas side boiler ash and slag deposits on a periodical basis. They direct a operating medium through nozzles against the soot or ash accumulated on the heat transfer surfaces of boilers to get rid of ash deposited on coils, and improve heat transfer potency. Soot blowers situated in boilers at numerous locations like water walls , superheaters , economizers and air pre heaters .in boilers while not sootblowers the warmth transfer won't as per the look and improve potency . Hence the study of sootblowers can effectively increase the boiler potency in power plants.*

Keywords: *Boilers, Nozzles , Coils etc..,*

I. Introduction

The soot blowers is associate degree act of applying within the boilers however variations within the locations like, the cleaning coverage needed and also the severity of the deposit accumulation.

- Soot blowers in the main consists of
- A tube part, that is inserted into the boiler and carries the cleaning medium.
- Nozzles within the tip of the lance to will increase the speed of steam flow and positions the cleansing medium.
- A system to rotate the tube element&
- A management unit.

The operating medium employed in soot blowers is also saturated steam, superheated steam, compressed gas or water. In most cases superheated steam area unit hand-picked as operating medium as a result of indicates that erosion of tube surfaces will occur due to the wetness contained in saturated steam. additionally superheated steam, when put next with saturated steam has larger cleansing potential attributable to the upper sonic speed through the soot blower nozzles as shown in figure 1.1.

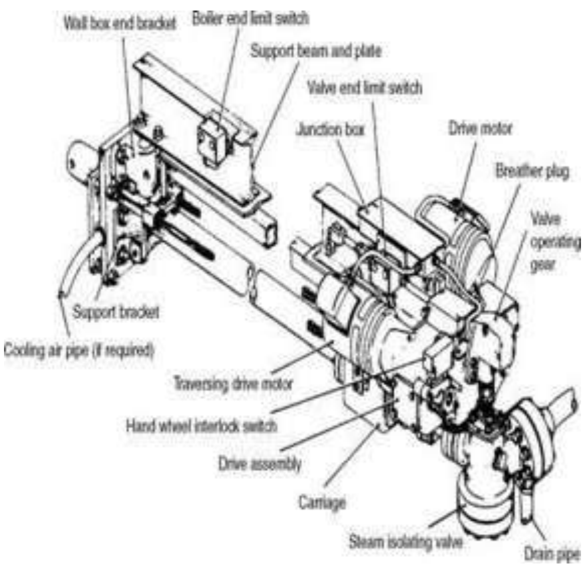

Fig1.1 Soot Blower

II. Literature Review

Atmega.et.al Boiler is one of the main equipment in thermal power plant. The Soot, ash on the surface of boiler tubes is still a great concern and affecting the efficiency of the coal fired boiler. At present soot blowers are operated manually in every shift. This project presents one of the embedded based industrial automation techniques for efficient operation of the soot blowers in both auto and manual mode, which also adopts the stack based temperature controlling of soot blower for optimization of soot blower control to increase the boiler efficiency. An automation technique is simulated in real time using PROTEUS .

Gowshikan.M.et.al The chemical recovery boiler utilizes the black liquor which is the waste liquidcoming out from pulp in paper industries. Soot blower is one of the major components required to clean the sediments deposited on boiler tubes which affects the heat transfer. Several issues like steam leakage, lance tube bending, ash deposition on lance tube and corrosion are frequently reported among the 28 soot blowers of SPB Ltd. Inthis project, the problems that occurring in soot blowers identified and analyzed. The problems are eliminated by the changing of material from stainless steel (310) to magnesium alloy (AZ91D). Solutions for corrosion, ash deposition and steam leakage are given for proper functioning of the soot blowers in the chemical recovery boiler.

III. Thermal Power Plant

In thermal station primarily potency are losses as a result of irregular heat transfer in boilers. Under fuel burning conditions temperature should be maintained some 1045^0 c .Boilers are classified primarily into two varieties supercritical boilers and subcritical important boilers. In subcritical important boilers steam are generated with facilitateof separate drum arrangement however, In supercritical boilers steam ready by itself while not facilitate of separate drum owing to boiling purpose reaches on top of the crisis, for subcritical boilers steam magnitude relation is 1:7 In boilers there are many coils like a super heater 1,super heater 2,super heater 3,economizer, re heaters in this once steam flows from one-coil to a different coil there'll be some losses occur in temperature of steam. Have to be compelled to maintain temperature and pressure for run turbine commonly a turbine desires 340^0 c temperature and twenty-four bar pressure and there additionally standardization in exhaust flue gas temperature around 150^0c.

IV. Steam Soot Blowers

Steam is taken from super heater SH2coil stage outlet, it's transported to soot blowers. The temperature of the super heated steam is approximate 440^0 C. Quantity of steam consumed per blower per operation is 750Kg. Performance of operation of is five minutes. Total time consumed for one cycle is one hundred twenty minutes. Every soot blower can cowl concerning 0.5 the chamber dimension as they travel in coiling direction. The soot blower includes a tube element with 2-venturi nozzles through that steam is blown on the tube bundles round the specific blower. The tube element Will be getting into the flue gas flow, with a rotating movement and obtain back to its original position.

During this, the nozzles movements in a helical direction. The two nozzles opposed each other and the spreading blowing jets ensure complete cleaning coverage during the whole movement of the tube as shown in figure 1.2.

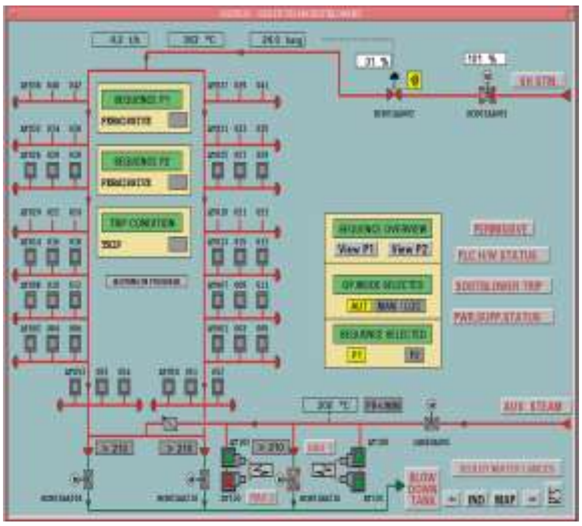

Fig.1.2 Sootblowers Arrangement In Boiler

V. Components Of Sootblowers

Steam Storage Tank

The boilers has an variation in temperature across the coils due to heat exchanges from that soot blowers collect an steam from super heater coil-2 with temperature 540 degree Celsius and stored in storage tank for future utilization. According to the use of sootblowers the steam temperature and pressure are changed for slag removing purpose.

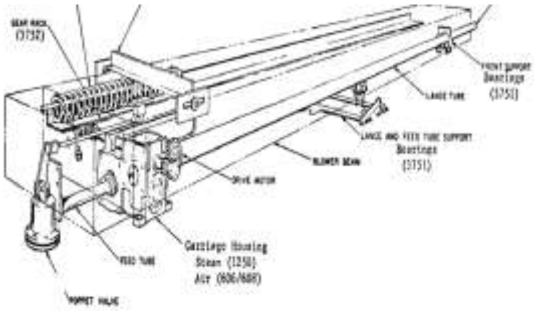

Fig.1.3 Components of Steam Soot Blowers

Steam Collector

Steam from the super heater-2 are stored in a storage tank for future purpose steam are applied through an nozzles .the steam are collected from the storage tank through motors with manual operations PLC and reduce the temperature and pressure for online cleaning.

Nozzle

A nozzle is a device designed to control the direction of a fluid flow (liquid or gas) nozzles are frequently used to control the rate of flow ,speed,direction, mass . Thenozzle velocity of fluid increases at the expense of its pressure energy .

Types of nozzles:

1. Jet
2. High velocity
3. Propelling
4. Magnetic
5. Vacuum

In steam soot blowers an vacuum type nozzles are used for cleaning purpose of coils .

Working Cycle

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 tubeelement 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 clean the tubes aroundboilers The carriage continuously concentrated, until the nozzles reach the front- end position. The limit switch located at the front- end position and reverses the position of rotation of the motor. Due to the reverse rotation the blower now startsretracting. before the nozzles reach the boiler wall, the blower valve closesand cut off the blowing . The rear-end limit switch cuts of the supply to themotor as soon as the lance tube comes to theoriginal position.

Temperature Of Coils Each Day

ENITRE COILS UNIT -1	1st day 12:15	3rd day 12:45	5th day 12:45
Furnance temperature left	846.94	894.55	916.10
Downstream SH1 FG temperature left	795.55	843.37	869.08
Downstream SH3 FG temperature left	690.	712.69	719.22
Downstream RH2 FG temperature left	580.27	594.29	600.83

Downstream SH2 FG temperature left	480.81	484.82	486.16
Downstream RH1 FG temperature left	394.79	397.72	400.76
FG temperature ECON 1st left	344.54	350.65	350.08
FG temperature ECON 1st outlet left	318.45	319.62	317.40
Raph outlet temperature	189	194.	191.52
U2 generated load	214.19	214.19	211.08
FLUE GAS temp to chimney	166	169.32	167.02
RAH1 inlet air temperatue	33.49	33.47	31.01
RH spray water flow	16.23	19.45	16.53

Model Caluclation To Find Efficiency Of Boiler
Note:
%Carbon = 30.750
%Hydrogen =2730
%Nitrogen =0.250
%Sulphur =0.580
%Oxygen=9.720
%Moisture =50.700
%Ash=5.270
Gross calorific value of FUEL =2723
Unburnt Fly ash =0.42
Unburnt Bottom ash =3.78
GROSS HEAT RATE =Turbine heat rate/Boiler efficiency
NET HEAT RATE = Gross heat rate/ (1-auxillary power)
AUXILLARY POWER =8.5%
FC = Fixed Carbon
A=Ash
M=Moisture
S=Sulphur
CO2=Carbon di Oxide
CO = Carbon Monoxide
O2=Oxygen
Cpg=Sp.heat of gas =0.24
Tf=Flue gas temperature
Ta=Ambient temperature
GCVa=Gross .calorific value of ash
GCVba=Gross .calorific value of bottom ash
EA =Excess Air
C = Carbon
H2=Hydrogen
N2=Nitrogen
Ma.the = Theortical mass of air
Ma.act =Actual mass of air
Mdfg =Mass of dry flue gas
Theortical Mass Of Air: Ma.the=[[11.6*%C]+[34.8*[%H2-[9.36/8]]]+[4.35*%S]]/100
=[[11.6*30.750]+[34.8*[2.730-[9.36/8]]]+[4.35*0.580]]/100
Ma.the=4.135
Actual Mass Of Air:
Ma.act = [1+ [%EA/100]]*Ma.th
EA= [%O2/ [21-%O2]]*100
EA=[9.720/[21-9.720]]*100
EA=21.387

Ma.act =[1+21.387/100]]*4.135
Ma.act =5.0193
Mass Of Dry Flue Gas:
Mdfg=[0.01*%c*44]/12+[%N2/100]+[Ma.act*.77]+[[Ma.act-Ma.the]*0.23]+[%S/100*2]
Mdfg=[0.01*30.750*44]/12+[0.250/100]+[5.0193*.77]+[[5.0193-4.135]*0.23]+[0.580/100*2]
Mdfg=5.2097
Efficiency:
L1=Mdfg*Cpg*(Tf-Ta)*100/GCVf
L1=5.2097*0.24*(141.71)*100/2723
L1=6.0955
L2=9*%H2*[584+CPS (Tf-TA)]/ GCVf
L2=9*2.370*[584+0.42(141.71)]/ 27 23
L2=5.772
L3=%M*[584+CPS (Tf-TA)]/ GCVf
L3=50.700*[584+0.42(141.71)]/ 2723
L3=11.91
L4= Ma.act*Humidity Factor * CPS (Tf-TA)]*100/ GCVf
L4= 5.0193*0.025* 0.42(141.71)]*100/ 2723
L4=0.2569
L5=%C0*%FC*5654/[GCVf*[%CO+%CO2]]
L5=0.001158*18.75*5654/[2723*[O.OO1158+11.63]]
L5=0.0387
L6=0.7
L7=0.2*%A*GCVba/ GCVf
L7=0.2*5.270*150/ 2723
L7=0.0580
L8=0.5*%A*GCVa/ GCVf
L8=0.5*5.270*50/ 2723=0.0774
L9= [Unburnt in bottom ash/[100Unburntinbottomash]]*[%a*0.2*8080*100/[100*GCVf]]
L9=[3.78/[1003.78]]*[5.720*0.2*8080*100/[100*2723]]
L9=0.120
L10= [Unburnt in fly ash / [100- Unburnt in flyash]]*[%A*0.8*8080*100/ [100*GCVF]]
L10= [0.42 / [100- 0.42]]*[5.270*0.8*8080 *100/[100*2723]
L10=0.0527
EFFICIENCY=100[L1+L2+L3+L4+L5+L6+L7+L8+L9+L10]
=100[6.0955+5.772+11.91+0.2569+0.0387+0.7+0.0580+0.0774+0.120+0.0527]
=100-25.081
EFFICIENCY=74.48

DAY's	PERIOD OF SOOTBLOWERS	EFFICIENCY
1st	BEFORE	74.48
1st	AFTER	74.97
2nd	AFTER	74.82
3rd	AFTER	74.77
4th	AFTER	74.66
5th	AFTER	74.58
6th	AFTER	74.48

GROSS HEAT RATE =Turbine heat rate/Boiler efficiency
=1944/0.7448
GROSS HEATE RATE=2610
NET HEAT RATE = Gross heat rate /0.915
=2610/0.915
NET HEAT RATE =2852
HEAT RATE BEFORE SOOTBLOWERS =2852
HEAT RATE AFTER SOOTBLOWERS =2834
Difference between sootblowers =18kcal

Power produced per day= 210*1000*24
=5040000kwhr
Total energy saved per day =5040000*18
=90720000
Calorific valve of fuel =2723kcal/kg
Fuel saved /day=90720000/2723
Fuel saved /day=33.316 tonnes/day
Equvilaent fuel =4.94 tonnes /day
TOTAL FUEL SAVED PER DAY =33.316-4.94
TOTAL FUEL SAVED PER DAY =28.37 tonnes/day.

VI. Result And Observation

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

We find out that in efficency of sootblowers in boiler function, Sootblowers are operated at 4 elevation in first elevation the sootblowers clean SH1 and SH3 coils from the reading we found that slag is more in this area and heat pick-up increases after sootblowers operation immediately and slag formation starts within 2 days .

In RH2 and SH2 area slag formation is moderate the heat transfer remains clean for 3-4 days after soot blowing .

In the RH1 and Econ area no slag formation is absorbed only find accumulation is note this because of sootblowers operation ,exhaust flue gas temperature came down 6-7 degree centigrade . After sootblowing increases the boiler efficency by about 0.5% The gain due to soot blowers operation at around 17 tonnes /day for soot blowersoperation we spent for slag removing purpose.

VII. Advantages Of Sootblowers

- According to the schedule as mentioned above and advantages of soot blower control, the boiler efficiency is increased by 5% to 10%.
- The overall efficiency increases nearly 2% to3% by having soot blower with temperature controlled mode.
- The effectiveness of cleaning around the superheaters,economiser.
- Low operating and maintenance cost.

Applications Of Sootblowers :

- Sootblowers are used in boilers for cleaning purpose .
- Soot removes slag formation in textile industries, etc…
- Blowers remove ash content in rap.

VIII. Conclusion

Now all the sootblowers operation are carried out in 7 days . The slag deposistsisuniform in the all coils the soottblowers schedule shall been modified as follows.

- 1^{st} row of coil shall be operated once in a day .
- 2^{nd} and 3^{rd} row of coil shall be operated twice in a week.
- 4^{th} row of coil shall be operated as per schedule

Soot blowers operation in thermal power station-1 expansion of NLC INDIA Ltd,was considered and all its operating parameters were studied for a 4 weeks and its performance was analyzed and compared with that the of design guarantee values.

At present design operation is carried out 7 days once since slag formation is not uniform around 4 elevations because of efficiency loss of boilers sootblowers operation are carried each elevation as per our observed modifications and maintenance suggested for increasing boiler efficiency

Reference

[1] Analysis of Clinker Formation Region and Soot Blower Optimization Using CFD Analysis by Bhatt Samik .
[2] Of Soot Blowing System In Boiler Furnace On Cycle Efficiency And Cost Saving by Dr. N. S. Venkatesh Gupta, Shivaraj Kumar .
[3] Root Cause Identification and Elimination of Problems in Soot Blowers of Chemical Recovery Boilers by M.Gowshikan, S.Ganesh Kumar, H.Surjith .
[4] Fundamentals of soot blowers" by A.K. Varshneya.
[5] Feasibility of using low pressure steam for soot blowing by Kaliazine A, Cormack D E, Tran H and Jameel, Pulp & Paper, Energy Conservation, Vol.107.4.