Investigation and Improvement in Steam Package Boiler Efficiency

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***Abstract*- In the present scenario of energy demand overtaking energy supply top priority is given for energy conservation programs and policies. Most of the process plants are operated on continuous basis and consumes large quantities of energy. Efficient management of process system can lead to energy savings, improved process efficiency, lesser operating and maintenance cost, and greater environmental safety. With the growing need for energy conservation, most of the existing process systems are either modified or are in a state of modification with a view for improving energy efficiency. Any new proposal for improving the energy efficiency of the process or equipment should prove itself to be economically feasible for gaining acceptance for implementation. The focus of the present work is to study the effect of system modification for improving energy efficiency.**

Index terms-: Efficiency improvement, boilers etc.

INTRODUCTION

A Boiler is a heart of thermal power plant. Boiler incorporates the fire bar and great furnace area to burn the fuel and produces heat which in turn heats up the water present in water tubes of boiler thereby producing steam.

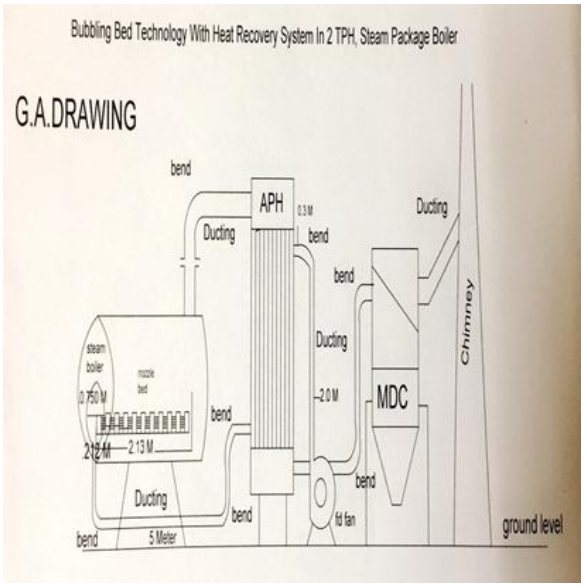
This produces the saturated steam which may vary according to the pressure above the boiling water. The saturated steam produced is used for various purposes in different areas like providing heat through hot steam to run the machines in textile, chemical, rubber, plastic plants etc. Higher the furnace temperature, higher the steam production rate.

There are several techniques to increase the efficiency of boiler which in turn gives more other advantages like reduce coal consumption, pollution control, proper feeding of fuel and many more. Presently, FBC (Fluidized bed combustion) is one of the effective method which is enormously increasing the efficiency of boiler and maintains the pollution control but it is very costly process.

We have studied a lot about the FBC process and by using fbc technique, we have discovered the new system called bubbling bed which gives the great result like fbc in increasing the efficiency of boiler in spite of low cost.

Our product solves the major problems which are faced presently in the boiler section and also gives the huge profit. As we are introducing the different components like wind box bed, F.D. fan, nozzles.

By implementing this system, first of all, it reduces the fuel consumption as it burns the fuel properly and proper combustion takes place because air-fuel ratio is matched. Secondly, due to proper combustion , the pollution which is occurring due to improper burning, many lumps are been galvanized with surface and ultimately the huge black smoke is uplifted through chimney in atmosphere, so it reduces the black smoke which converts into white smoke.



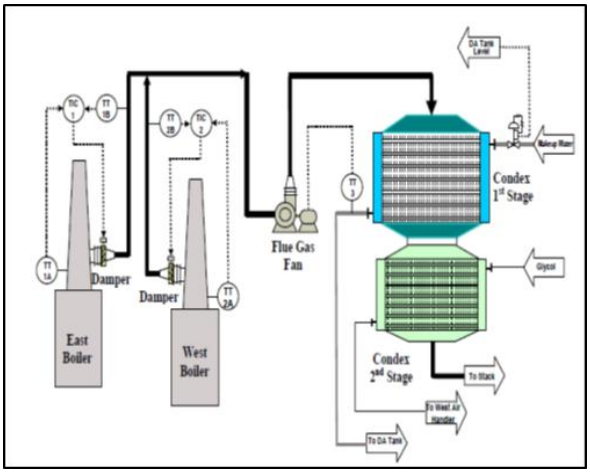
Condex System

The most essential component of the system is the flue gas condensing heat exchanger, namely ConDex. This maximizes water vapor condensation and hence recovering both latent heat and sensible heat from the flue gases.

Construction of the ConDex systems consist of stainless steel tubes and aluminum fins which helps in increasing the heat transfer surface area. Aluminum fins are excellent corrosion resistant.

ConDex was designed to operate with the existing boilers without disturbing its basic operation. Schematic diagram of the ConDex and the boiler is given. At a given load on the boiler, water will be supplied to the first stage of ConDex and the induced draft is started. Thus the variable frequency drive will adjust the boiler loads to maintain negative pressure at the inlet duct, hence it helps in capturing the flue gases throughout the boiler. When the load on the boiler increases beyond designed flue gas flow, the excess gas will not be conveyed to the exchanger as the supply fan is at max capacity.

SCHEMATIC DIAGRAM OF THE CONDEX UNIT



Components needed

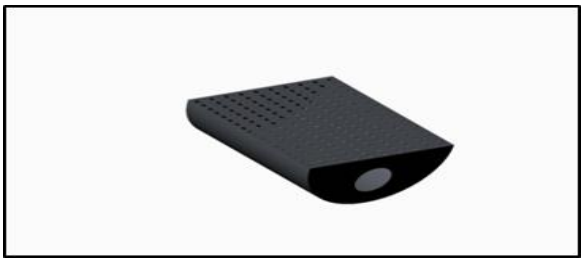
a. Wind box Bed
b. Nozzles
c. Forced draft fan
d. Screw feeders

a. Wind box Bed

It is basically a square or circular bed of mild steel material which will have holes on its top plate in which nozzles are fitted.

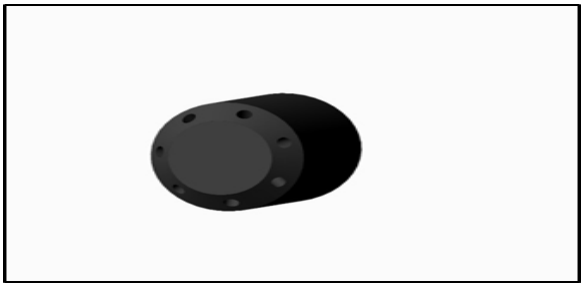
It also contains the duct of F.D. fan for transmission of air to furnace area

Its top surface is filled with RC so that only nozzle holes for air are visible and hence the flat surface for proper combustion is generated.



b) Nozzles

- It is made up of stainless steel material and are inserted in wind box bed.
- These nozzles helps in transmitting the well circulated air from F.D. fan to combustion place.
- It also helps in proper combustion of fuel/coal in the furnace.
- Proper spray of air can take place
- No leakage due to RC platform in surrounding

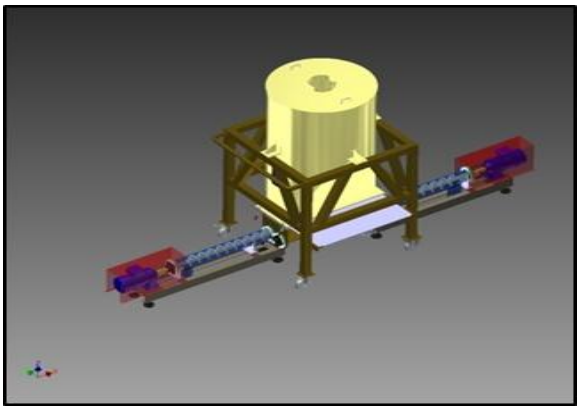


c) Forced Draft Fan

- It is a type of Centrifugal fan
- It is introduced in order to get proper circulation of air to the combustion place
- One of its duct is opened to wind box bed and the other is opened to screw feeder
- Using this any worst fuel can be combusted easily

Screw Feeder

- It will help in proper amount of fuel feeding rather than traditional ways of manual feeding which causes wastage of fuel.
- It also has a screw for regulating the feed
- It will reduce the manpower and manual input
- It also affect the cost in long run as it reduce the wastage of coal due to proper regulation
- Feeding of coal can be regulated at any time by a regulator



- Process Parameters (Before Installation)
- Boiler (2TPH)
- Boiler feed temperature :600C
- Steam outlet pressure : 6kg/cm2
- Steam outlet temperature :1620C
- Fuel (imported coal) quantity : 250kg/hr
- Steam output :1500kg/hr
- G.C.V. of imported coal : 5500Kcal/kg
- Flue gas outlet temperature :2200C

Boiler efficiency
Steam generation X (Enthalpy of steam – enthalpy of boiler feed water)

Fuel Consumption X G.C.V of fuel

= 1500 X (658 - 60)

250 X 5500
= 65%

Combustion efficiency
= 100 – (dry flue gas loss – loss due to evaporation of water – loss from evaporation of fuel moisture – loss from unburned CO – heat loss due to moisture in air – heat loss due to unburn in fly ash – radiation loss
= 100 – (6.2 – 2.4 – 2.8 – 1.6 – 0.8 – 1.2 – 2)
= 83%

Process Parameters (After Installation)

1. Boiler (2TPH)
   Boiler feed temperature : 60^0C
2. Steam outlet pressure : 6kg/cm^2

- Steam outlet temperature : 1620C
- Fuel (imported coal) quantity : 218kg/hr
- Steam output : 1500kg/hr
- G.C.V. of imported coal : 5500Kcal/kg
- Flue gas outlet temperature : 2200C

Boiler efficiency
Steam generation X (Enthalpy of steam – enthalpy of boiler feed water)

Fuel Consumption X G.C.V of fuel

= 1500 X (658 - 60)

218 X 5500
= 75%

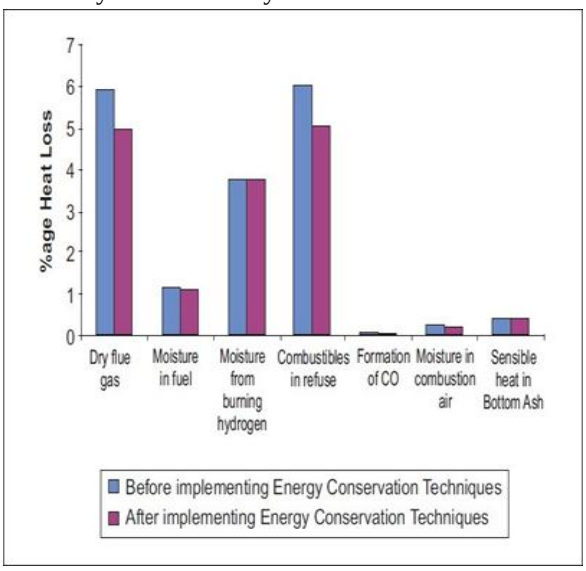
Combustion efficiency
= 100 – (dry flue gas loss – loss due to evaporation of water – loss from evaporation of fuel moisture – loss from unburned CO – heat loss due to moisture in air – heat loss due to unburn in fly ash – radiation loss
= 100 – (3.4 – 1.1 – 0.9 – 0.7 – 0.4 – 0.6– 0.9)
=92%

CONCLUSION

So we after working hard on the project and going through each and every points we concluded that If we are going on the right track we will be able to modify the existing system and implement our idea, then first of all this system would be able to Reduce Fuel Consumption, burns the fuel properly and proper combustion takes place because air-fuel ratio is matched. This in turn will automatically Increase efficiency of boiler for this to happen we are Using Forced Circulating Air Equipment like force draft fan.

Secondly, due to proper combustion , the pollution which is occurring due to improper burning, many lumps are been galvanized with surface and ultimately the huge black smoke is uplifted through chimney in atmosphere, so it reduces the black smoke which converts into white smoke.

We are finding Alternate for fire bars so that proper burning take place without wastage. We will use wind box proper and even circulation of air for the entire chamber. We will fit stainless steel nozzles on the holes present on the wind box which will help to transfer the required amount of air into the chamber. The surrounding space between the nozzles would be filled up with R. C. C so that no fuel falls down. The next would be Screw feeder which would feed the coal in an appropriate amount into the chamber for proper mixing and hence these will increase the efficiency of the boiler system.



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