International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137

Volume – 02, Issue – 03, March – 2017, PP – 64-68

Optimization of Boiler Operation In Thermal Power Station

U. Sundaravinayaka ,T.Jayapaul
Assistant Professor, Madawalabu University, Ethiopia.
(UG student),Velammal Institute of Technology,

Abstract: This project work deals with the **"Optimization of Boiler Operation "**in THERMAL POWER STATION. We have studied in detail about various existing system in boiler and process of power generation and analysed possibilities of optimization. Accordingly, we propose few points of optimization to improve boiler efficiency .In this regard we propose and suggest optimization three systems, one related to operational area and other two related to maintenance aspects. Various parameters can be optimized like air flow ,coal flow usage of coal with less ash content , air fuel ratio ,proper evaluations ,ensuring minimum reduction of **co**, increase in insulation parameter and other. We devised a method to increase the boiler efficiency and this can be brought to effect by increasing heat absorption by increasing the economizer area. Based on this area the boiler efficiency at the existing condition is determined and the anticipated improvements after optimization are discussed in this project.
Keywords: Boiler Losses, Efficiency.Rankine Cycle, Optimization.

Introduction

A steam based thermal power plant operates on the Rankine cycle and the power plant efficiency can improve by improving the efficiency. To increase cycle efficiency, to heater, regenerative heating system, economizers are incorporated in the system. A power cycle continuously converts heat into work, in which a working fluid repeatedly performs a succession of processes.
In a thermal power station is following cycles will followed
(i)Reheat Rankine cycle
(ii)Modified Rankine cycle
(iii) Regenerative cycle

The superheated steam produced in boiler is supplied into a steam turbine where its thermal energy is Converted into mechanical work on the turbine shaft. In this case all the steam after partialexpansion in the turbine (HPT) is brought back to the boiler, r-heated by flue gases and then fed back to the turbine for further expansion at IPT & LPT The turbine is connected to an electric generator in which the mechanical energy is transformed into electricity.

BOILER

Boiler is a closed vessel which is used to produce steam under heavy pressure. In other words boiler is nothing but steam generator.As per Indian boiler regulation "Boiler is a closed vessel having capacity of more than 22.75 liters and it is used generate the steam under pressure and provide with all necessary mounting and other fitting for the safety reliable operation".

STEAM SYSTEM

Saturated steam produced in water wall zone is further super heated to a specified temperature in steam super heater. Depending upon the mode of the heat transfer, super heaters are divided into convective super heater, which are located in the inter pass and second pass of the boiler and absorb heat mainly by convection, and radiant super heaters which are arranged on the furnace walls and absorbs the radiant heat of the flame.In 210MW boiler, super heater are divided into primary super heater i.e. low temperature super heater (LTSH), platen super heater, pendent or super heater and re- heater, in which the worked- off steam returned from the HP turbine is super heated once again.This system consists of riser tubes, super-heaters, Re- heater & De-superheater etc.

Flue gas temperature in different locations of the boiler

Location of the boiler	**Flue gas temperature (^0C)**
Leaving furnace	1124
Before re-heater	1011
After re-heater	789
Before LTSH	689
Before economizer	462
Before air preheater	370
After air preheater	148

Table 1 Flue Gas Temperature

Feed water and steam temperature in different location of the boiler

Location of boiler	**Feed water temperature (^0C)**
Economizer inlet	240
Economizer outlet	276
Boiler drum	345
LTSH inlet	347
LTSH outlet	422
Platen SH inlet	422
Platen SH outlet	515
Pendant outlet	540
RH inlet	332
RH outlet	540

Table 2 Feed water Temperature

BOILER EFFICIENCY

In general, efficiency is defined as the ratio of output to input.

Boiler Efficiency= (output/input) ×100

Boiler efficiency is defined as the ratio between the powers produced from the boiler and the fuel supplied to the boiler. In another way boiler efficiency is obtained by subtracting all the losses affecting boiler performance from 100.

Efficiency = (Input-losses)

A phenomenon which affects the boiler performance or efficiency is known as loss. The losses in the boilers are classified into two types

1.Controllable losses

2.Uncontrollable losses

Controllable losses

Controllable losses are the losses which can be controlled by maintaining optimum parameter. The following are controllable losses.

- Dry gas loss
- Mill rejection loss
- Carbon loss

Uncontrollable losses

Uncontrollable losses are the losses which cannot be controlled. The following are uncontrollable losses.

- Loss due to moisture in fuel
- Loss due to hydrogen in fuel
- Loss due to moisture in air
- Loss due to sensible heat of ash
- Loss due to radiation

Boiler losses

The calculation of boiler losses in thermal power plant

ULTIMATE ANALYSE OF COAL (%)

Carbon	36.92
Ash	37.82
Nitrogen	0.87
Oxygen	7.51
Sulphur	0.28
Moisture	14
GCV of fuel	3330kCal/kg
Volatile matter	22.8
Fixed Carbon	25.28

Table 3 Ultimate Analysis Of Coal

Carbon loss	-1.22%
Dry gas loss	-5.773%
Fuel moisture loss	-2.89%
Air moisture loss	-0.18%
Sensible Heat los s	-0.1711%
hydrogen loss	-0.0574%
sensible heat of fly ash	- 0.3979%
Mill Rejection loss	-0.0425%
Co loss	-5.868%

Table 4 Boiler Efficiency

Boiler efficiency = 100(1.22+5.77+2.89+0.052+0.18+0.17 +0.3+0.05+0.04+5.86)
= 100-16.53
= 83.47%

OPTIMIZATION OF THE AIR PRE-HEATER OF BOILER

Air heater is a heat transfer surface in which inlet air temperature is raised by transferring heat from the flue gas. Since the air preheater can be employed successfully to reclaim heat from flue gas to low temperature levels, then is possible with economizer, heat rejected to chimney can be reduced to higher extend. For every 20 ^{0} C drop in the gas exit temperature the boiler efficiency increase by about 1.0%. In addition to increase in overall boiler efficiency.

OPTIMIZATION REPLACING HOT END BASKETS

The air heater consists of layer of heat transfer elements of 850,850,300mm height each. The flue gas with 350oC is entering into the hot end of the air heater causes erosion on the hot end baskets during heat transfer. The baskets are required to be replaced where the depth of erosion is more than 25mm. it is difficult to remove and replace the hot end elements fully for the erosion since the process shall consume considerably more time, cost and labour. So the hot end layer is sub-divided into 2 segments as 200mm + 650mm. instead of replacing the baskets of 850mm height we can now easily replace the baskets 200mm height and 650mm baskets may be reversed and reused. The modified maintenance methodology shall result in reduction of maintenance cost & time and labour, appreciably.

REPLACING SINGLE SEALS BY DOUBLE SEALS

At present the air preheater segments are sealed by single sealing at 30oapart. In this method the sealing surface is minimum and the angle between the adjacent seals is 30o. The leakage in air pre-heater is more i.e., leakage of primary and secondary air it to flue gas due to lack of perfect sealing. To prevent this leakage, frequent maintenance words are required to be carried out and periodic monitoring is required. The leakages reduce the performance of the equipment and reduction in efficiency. The leakage shall lead to higher gas velocity that affects the performance of ESP. further this will result in excessive loading of ID(induced draft) fans, PA fans and air preheater itself. Consequently, the boiler efficiency gets reduced and the cost of generation gets increased.

the air preheater when compared to single sealing and the performance of air preheater is increased To avoid the above mentioned deficiency the single sealing is replaced by double sealing. The double sealing is a method of increasing the area of sealing surface. In double sealing for every 15^0 rotor angle
one seal is provided instead of $30\ ^0$. Flue gas outlet temperature of air preheater is reduced from 169 ^{0}C

(3) RESULT AND DISCUSSION

S. No	Parameter	Observed Reading	Value After Modification
1	Unit Load	210MW	210MW
2	Total Coal Flow	141 T/Hr	118 T/Hr Designed
3	Total Air Flow	968 T/Hr	848 T/Hr
4	Coal Moisture	5.55%	5.55%
5	Hot PA Temp	2980C	341 ^{0}C
6	Hot SA Temp	298oC	335 ^{0}C
7	FGI/L Temp APH	355oC	364 ^{0}C
8	APH O/L FD Temp	163oC	147 ^{0}C
9	PA Fan IGV Position	31%	25%
10	MillO/L Temp	83oC	77 ^{0}C
11	GCV of Coal(gross calorific value)	3330Kcal/Kg	4260Kcal/Kg(Designed)

Table 5 Result and Discussion

CONCLUSION

Thus by the optimization proposed, the existing scanner air system can be kept as stand by, then the operating and maintenance cost will be reduced appreciably .By adopting the optimized ash collection system the outages has been minimized and boiler tube punctures are been reduced considerably. In air preheater system, the outlet can be reduced from 163 ^{0}C to 147 ^{0}C. For every 22 ^{0}C of temperature reduction, the boiler efficiency is gained by 1%. As per optimization suggested savings / annum is around 1.130 crores. Various parameters can be done by testing the boiler regularly.

The Thermal performance of the air preheater is improved. Load on the fans are reduced thus power consumption is reduced and cost is reduced. Fuel consumption is also reduced, thus fuel is saved and cost is reduced.

REFERENCES

[1]. P.K.Nag. Power Plant Engineering, Tata Mc Graw Hill Publication,Third Edition 2014

[2]. R.K.Rajput Power Plant Engineering,Laxmi Publication,Eighth Edition 2014

[3]. R.S.Kurumi ,Thermal engineering,S.Chand Publication, Fifth Edition 2014

[4]. Coal Drying Improves Performance And Reduces Emissions1 ,Charles Bullinger and Mark Ness Great River Energy Underwood, North Dakota 58576-9659

[5]. Improvement of Boiler Efficiency in Thermal Power Plants,A. Ashokkumar,Middle-East Journal of Scientific Research 12 (12): 1675-1677, 2012 ISSN 1990-9233©IDOSI Publications, 2012 DOI: 10.5829/idosi.mejsr.2012.12.12.23

[6]. Improving Boiler Efficiency By Using Air Preheater V. Mallikarjuna, N. Jashuva, B. Rama Bhupal Reddy International Journal of Advanced Research in Engineering and Applied Sciences ISSN: 2278-6252

[7]. An Approach Towards Efficient Operation Of Boilers ,Amit Kumar Jain, International Journal of Scientific & Engineering Research, Volume 3, Issue 6, June-2012 1 ISSN 2229-5518

[8]. http://www.tneb.in/linkodf/tmtps.pdf

[9]. http://en.wikipedia.org/wiki/mettur

[10]. http://www.apgenco.gov.in/administrator/uploaded files/thermal power plant.pdf

