

Performance analysis of economiser, reheater and air preheater in 210mw boiler at mtps-1

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Abstract:-The main objective of the project is to study and understand the working and power production methods of MTPS-1. The boiler performance including its ability to meet full load, auxiliary power consumption, net plant heat rate, availability of the unit, operation and maintenance cost. Economizer and air pre-heater improves the economy of the steam boiler. Economizer increases the steam raising capacity of a boiler i.e., it shortens the time required to covert water into steam. It prevents formation of scale in boiler water tubes. There is about an average of 18% of coal saving. Since the feed water entering the boiler is hot, therefore strains due to unequal expansion are minimized Air heater is a heat transfer surface, in which inlet air temperature is raised by transferring heat from the fuel gas. Since the air preheater can be employed successfully to reclaim heat from the fuel gas to low temperature levels, than is possible with economizer, heat rejected to chimney can be reduced to higher extend. For every 20° C drop in flue gas exit temperature the boiler efficiency increases by about 1.0%.In addition to increase boiler efficiency. Electrostatic precipitator contains 24 fields are available in each boiler to separate almost 99% of ash and delivers in dry of wet from according to the requirement of the disposal. First age chimney height is around 130 meters and the second stage is above 220 meters. The field effective analysis is made in order to improve the efficiency of electrostatic precipitator

KEY WORDS: ECONOMISER, ELECTROSTATIC PRECIPITATOR, EXHAUST GAS, PREHEATER, STEAM RAISING, UNEQUAL EXPANSION.

INTRODUCTION

Coal fired thermal power plant generates major portion of India's electricity. The coal burns in the furnace to generate superheated steam which drives a turbine connected to an alternator to generate electricity.first stage consists of unit I&II of 210MW each. The second stage consists of unit 210MW. All the units are coal based; coal is

transported by sea through ships from Hadia, Paradeep, vizag ports to TTPS. LP economizer is heat recovery system in which heat is gained from the exit flue gas. It is similar to the economizer in boiler. Economizer can be provided to utilize the flue gas heat for pre-heating the boiler feed water. On the other hand, in an air pre-heater, the waste heat is used to heat combustion air. In both the cases, there is a corresponding reduction in the fuel requirements of the boiler.

Economizer coil The location and wind direction for Air cooled Steam condenser in thermal power plant plays a very vital role in their performance as earlier said its efficiency is inversely proportional to the ambient temperatures As the air passes from various heated equipment like Boiler, Air Pre-heater, Economizer, Electrostatic Precipitator (ESP) etc.

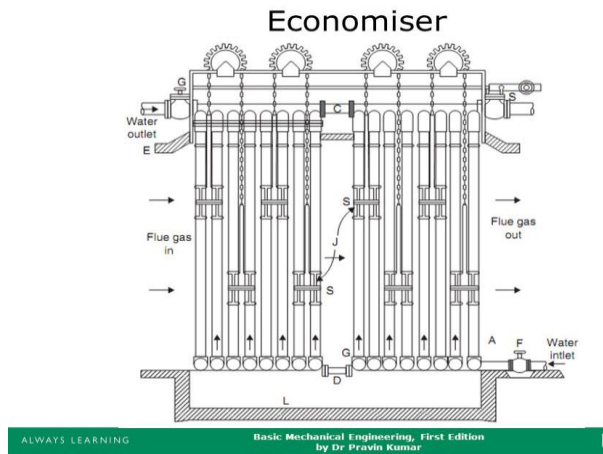
At present there is a vast margin of about 50 degree C which can be still be using the waste heat admitted along with the flue gases after Air preheater.

Abbreviations and Acronyms

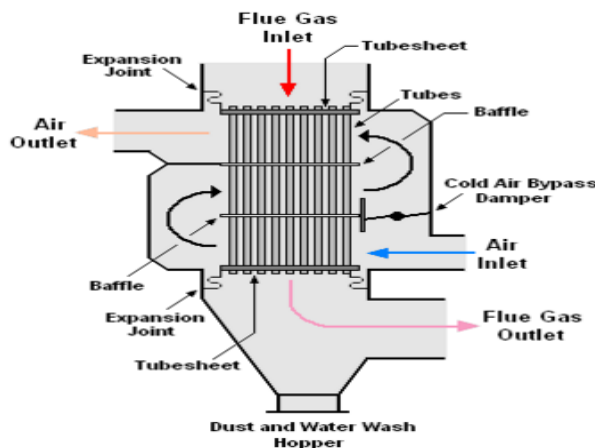
The method here used includes, a basic study of entire plant workings and deep study on the accessories on which tapping has to be done, collection and allocation of necessary values and data from operational manuals, obtained values from divisional engineers, supervisors, service books etc. With the data collected, the amount of Mass flow rate/ Volume flow rate of hot air required to make substitution for the set of heating coils of capacity 6kW for each hopper to make temperature of 120o -130oC around the shell of hopper.

The purpose of economizer is to preheat the boiler feed water before it is introduced in to the boiler and to recover some of the waste heat from the flue gases leaving the boiler.

The position is preset near the final bend, wind box where hot air tapping is to be done. The reserve among the source and sink is around 40 meters. So the fever drop due to heat relocate in the duct, with the specific insulation thickness, is calculated .



The feed water is pumped from the condenser to series of low pressure heaters after this stage the feed water enters the high pressure heaters for again raising the temperature. After gaining considerable rise in temperature, the feed water enters the economizer. From the economizer the feed water is sent to the boiler drum for generation of steam. The heat for the low pressure and high pressure heaters extracted from the turbine at different locations. The heat for raising the temperature of the feed water in the economizer is derived from the flue gas. The flue gas provides required heat for heating up the feed water in the economizer. It also provides required heat for heating primary and secondary air in the air preheater. After heating the air in the air preheater the flue gas is sucked by the induced draft fan through the flue gas duct.



The sucked gas reaches the electrostatic precipitator for the removal of fly ash from the gases. Dexin Wang developed to extract a portion of the water vapor and its latent heat from flue

gases based on a nano porous ceramic membrane capillary condensation separation mechanism. The recovered water and heat can be used directly to replace power plant boiler makeup water to improve its efficiency, and any remaining recovered water can be used for water makeup or other plant uses. The technology will be particularly beneficial for coal-fired power plants that use high-moisture coals and/or Flue Gas De Sulphur cation for flue gas cleanup. Chaojun Wang emission resulted from the low pressure economizer installation are assessed for three cases in a 600 MW coal-fired power plant with wet stack. Serpentine pipes with quadrate finned extensions are selected for the low pressure economizer heat exchanger which has an overall coefficient of heat transfer of 37 W/m.

NEED AND SCOPE

It is used in all modern plants. The use of economizer results in saving fuel consumption, increases steaming rate and boiler efficiency. Some of the common applications of economizer are given below, In steam power plants it captures the waste heat from boiler stack gases (flue gases) and transfers it to the boiler feed water. Air-side economizers HVAC (Heating, Ventilation and Air Condition) can save energy in buildings by using cool outside air as a means of cooling the indoor space. Refrigeration: This is commonly used in industrial refrigeration where vapour compression refrigeration is essential. Systems with economizers aim to produce part of the refrigeration work on high pressures, condition in which gas compressors are normally more efficient

Advantages and Benefits of Economizer&Air preheater

It recovers more heat of flue gases which normal air pre-heater cannot do. Due increase in fuel prices, all power plants are facing pressure for increasing boiler efficiency. So by using economizer, this pressure can be minimized. Power plants where it is not used, large quantity of water is required to cool the flue gas before desulphurization which is minimized by using economizers. The efficiency of power plant reduced when steam air pre-heater required steam. Air heater is a heat transfer surface, in which inlet air temperature is raised by transferring heat from the gas. Since the air preheater can be employed successfully to reclaim heat from flue gas to low temperature levels, than possible with economizer, heat rejected to chimney can be reduced to higher extend. For every 20°C drop in flue gas exit temperature the boiler efficiency increases by about 1.0%. In addition to increase boiler

efficiency, the other advantages are, Stability of combustion by increased temperature of air admitted for combustion. The hot primary air is used for drying coal in the mill for better grinding and carrying coal power. Better combustion of poor quality of coal, having low volatile content. Reduction in incombustibles in flue gas. The above design deficiencies have the following effect on the APH performance.

- a) Increase in Aux. Power consumption due to increase in P.A & I.D fan loading
- b) Increase in APHs maintenance due to high erosion of APH internals
- c) Less P.A header pressure due to non-availability of margin in fan loading.
- d) Increase in O₂ in flue gas after APH due to seal leakage.
- e) Difficulty in maintaining mill outlet temperature.
- f) Avoidable forced outage of unit due to falling of hot end sector plate because of tie rod erosion.
- g) Dust nuisance and environmental hazards in APH area due to leakage, especially in guide bearing area.
- h) Reduced boiler efficiency.

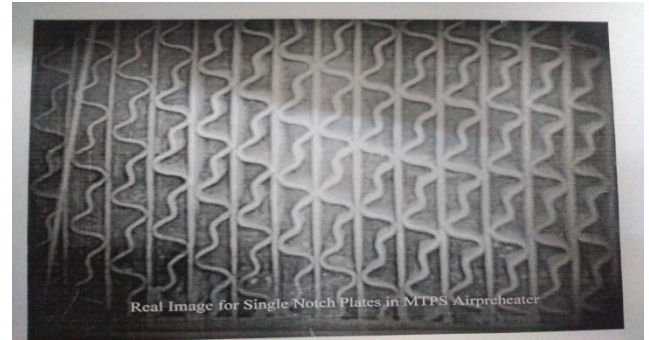
WORKING PRINCIPLE

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 subdivided 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.

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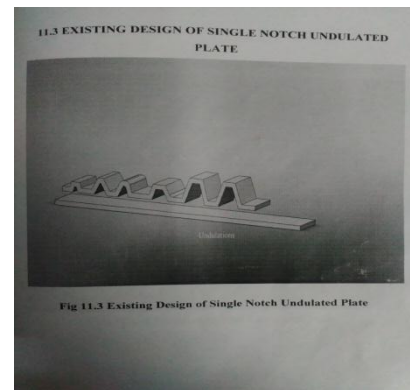
Replacing Single Seals by Double Seals

At present the air preheater segments are sealed by single sealing at 30° apart. In this method the sealing surface is minimum and the angle between the adjacent seals is 30°. The leakage in air preheater is more i.e., leakage of primary and secondary air in to flue gas due to lack of perfect sealing. To prevent this leakage, frequent maintenance works are required to be carried out and periodic monitoring is required. The leakages reduce the performance of the equipment and reduction in efficiency.

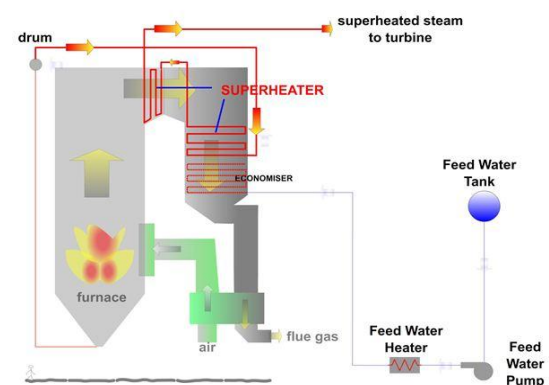


The leakage shall lead to higher gas velocity that affects the performance of ESP. Further this will result in excessive loading of ID fans, FD fans, PA fans and Air preheater itself. Consequently, the boiler efficiency gets reduced and the cost of generation gets increased. To avoid the above mentioned deficiency the single sealing is replaced by double sealing. The double sealing is method of increasing the area of sealing surface. In double sealing for every 15° rotor angle one seal is provided instead of 30°. This will enhance the sealing in the air preheater. By implementing this double sealing the leakage are minimized in the air preheater when compared to single sealing and the performance air preheater is increased.

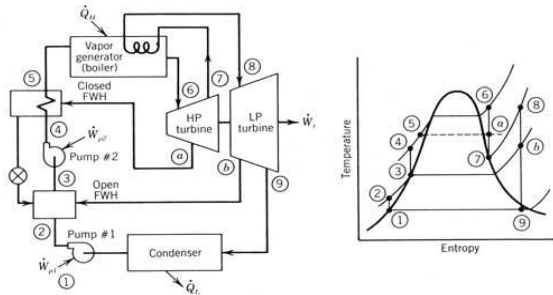
Double seal arrangement



REHEATER



They are the same as the super heater but as their exit temperature is a little bite less super heater and their pressure is 20%-25% less then the super heater ,they can stand less quality material alloys.



Analysis of Field Failure

The field failure data were calculated from unit 1 and 2 of MTPS as mentioned in table for reference . Causes for Under Voltage and Field Short The following were found as the causes for the under voltage, which leads to field short in ESP, during the observation: No Rapping Even though the rapping motor runs at the set rpm, sometimes there will be inefficient rapping or even no rapping.

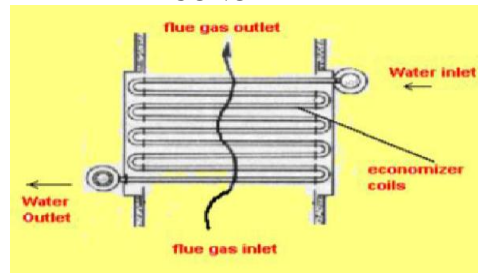
This may due to: 1. Wear and tear of hammer, hinge, pin etc of rapping mechanism. 2. Erosion of frame joints with collection plates. So that when the rapping hammer hits the frame, the vibration will not be passed on to the collector plates. 3. when there is no rapping, the thickness of ash particle layer sticking onto the collector plates and emitter plate increases. 4. Bending of Collector Plates The bending of collector plate may be due to 1. The striking of flue at high velocity along with some foreign materials such as materials such as metal pieces. 2. The high voltage applied to the collector plates. 5. Erosion of Collector Plates at the Joining The joint of the collector plate with the frame maybe eroded due to its continuous exposure to the high velocity flue gas. when it gets eroded, rapping becomes ineffective and also there is a change of collector. 6. Accumulation of Ash in the Hopper After rapping, the ash is collected in the bottom of the ESP hopper .if the ahs from the hoppers is not removed continuously either by water jet or dry ash removal system.

7. Erosion of Gas Distribution Screens In case of erosion of the primary and secondary gas distribution screens inlet of the ESP, metal pieces or foreign materials enters into ESP along with the flue gas and hit the collector or emitter electrode which causes field short. 8. Improper Closing of Doors at the Top If the doors of the insulator cover at the top of the ESP are not closed properly, there is a change for the rain water to enter into ESP, which suddenly causes field short. 9. Erosion of Distribution Plates at the Sides Due to the continuous exposure of the gas distribution plates at the sides

of the collector plates of the flue gas at high velocities these plates can get eroded, then the flue gas may escape through the gap between the collector plates.

Figures and Table

ECONOMIZER



COMPARISON TABLE

PERFORMANCE		
PARAMETERS	STANDARD VALUE	MODIFIED VALUE
Mass fiow rate of fuel	144tn/hr	139.8tn/hr
Length of economizer tubes	31.756km	44.38km
Area of economizer	4439.62m ²	6204.11m ²
Head gained	3531.6kj/s	4866.69kj/s
Efficiency	81.24%	81.94%

AIR PREHEATER



S.N O	PERFORMANCE		
	PARAMETERS	NOTCHED PLATE	DOUBLE UNDULATED PLATE
1	Length of the plate	1.7m	1.7
2	Width of the plate	42.8m	65.5m
3	Area of plate per profile	72.8m ² (0.0728m ²)	111.5m ² (0.1115m ²)
4	Head transfer rate per profile of primary air side	25.6656w	55.39w
5	Head transfer rate per profile of secondary air side	23.600w	36.1458w

CONCLUSION

The design arrangement and operation of 210MW Power plant boiler and its associated system were studied in detail. It is observed that the APH outlet flue gas temperature is higher than the design value. Finally the cost wise savings per year is worked out to 216 lakhs and the revamping and also augmentation cost shall be paid back within 3 years. The life of the renovated equipments shall be 12 to 15 years with routine maintenance works. Air preheater recover heat from outgoing the flue gas, the temperature of the flue gas is above the predicted design value there is considerable loss in efficiency.

The performance of APH can be improved there by increasing the efficiency of boiler by 1.13%. By optimizing and modernizing the sealing arrangements leakage in APH minimized there by improving the performance of ID, FD and PA fans and increasing APH efficiency 3.3%. By optimizing the heat transfer elements the performance of the air pre heater is improved there by increasing the efficiency of the boiler. By optimizing the sealing arrangement by minimizing leakage there by improving the performance of ID, FD, & PA FANS. The stack emission norms fixed by the state pollution control board stipulates that the stack emission level should be within 100 m/Nm³. Hence, our suggestions for the improvement of the performance of ESP system are given. The efficiency of the ESP system will definitely be improved, in case our recommendations are considered for implementation This is a method to return heating

coils with the presented heat source. This is the manner which can be done without upsetting the routine operation. But the implementation and testing can be done only during the shutdown period of 40 days every year. Thus by this recommended method more amount of energy and cost can be saved which automatically increases the capacity factor of the plant.

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