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A BRIEF REVIEW ON WATER TUBE BOILER AND BASIC PROBLEM WITH ITS SOLUTION

Chandresh J. Saresa
Department of Mechanical Engineering,
Chandigarh University, Mohali, Chandigarh – Punjab, India – 140413

Abstract— **In this paper study about the after the analysis of exergy and energy to get high performance and efficiency. After the analysis of exergy some % of losses are in the boiler. In study of that losses and said that if increase in performance and efficiency more after the find the efficiency of boiler by analysis of exergy. So, we focus on losses and find their best solution of that and can reduce the percentage of losses by studying of it. We knew that some losses are note gone but some percentage of their losses are reduced. Many problem and causes are in study in this paper. Researchers research that 100% work is not possible that's why we try to maximize the more work produce by decrease in losses and get 5% to 10% more efficiency than actual efficiency.**

Keywords— **Boiler, NTU, LMTD,**

I. INTRODUCTION

In 21st century most of electricity is occasion from steam power plant. The main origin of generate power in India is thermal. The generation of power from the thermal is more than the other sources. The main goal of use thermal power plant is to satisfy the demand of energy. In Mechanical application many type of boiler are available for its application and many boilers are used for it via different areas. Boiler is a closed vessel to convert water and liquid into gas or steam and this steam or gas is use for various heating application like central heating, boiler-based power generation, water heating, cooking and sanitation. Boiler is made of two ways first is the wall of bricks and the second is material like stainless steel, brass and wrought iron and etc. boiler is applicable for many areas like operating steam engine, operating steam turbine, operating reciprocating pumps, in chemical industry and more in thermal power station and mechanical areas. In bricks boiler wood and coal are use and the use of this the major problems are come in boiler and steel boiler some problems are present in that type of boiler.

In currently development in renewable energy is major part of the use of boiler in thermodynamics areas. Analysis of energy base on thermodynamic first law has some inborn limitation, say that not consider environment system and shame of the quality of energy through careless process. Analysis of energy don't characterize irreversible process in system. Analysis of exergy of the system that do characterize the potential of the system and Exergy is based on thermodynamics second low. In development of energy is fast craze in emerged crucial in environment and greenhouse effect at this stage 80% electricity produce in coal, petroleum, oil and natural gases and 20% electricity is produce in hydraulic, nuclear, wind, solar and geothermal and biogas. Recently analysis of exergy is most important tool in thermodynamics area and it is most usable is today for lasting development in quality and quantity. In this paper focus on exergy analysis of tube boiler and what is difficulty are face during experiment on tube boiler and which kind of problem and what is their significant solution of it. For tube boiler metal tubes are placed inside the boiler and there are two types of tube boiler first is water tube boiler and second one is fire tube boiler. In water tube boiler water is circulate in tube and heated by hot gas in outside and for fire tube boiler hot gas is pass through a tube and water is circulate outside the tube.

II. LITERATURE REVIEW

In currently the generation of steam is crucial in steel production. In water tube boiler the capacity of generation of steam is 47 tons per hours. For better understanding analysis of exergy and energy and its equation for find best method to generate steam [1]. In day by day increase in use of energy and in India demand is high for energy for this find best method to utilized most % of energy was generate and reduce % of losses in the generate the steam [2]. Use of exergy and energy utilized and analyses to boiler in this the efficiency and performance are compare with other boiler to decide to which is high efficiency and how many percentage of it [3]. In research of exergy and energy analysis, exergy efficiency is varying 57.7% of coal-fire circulating system and combustion simulation efficiency is decrease in SO2, CO and NO in the system [4]. For use west solid as generate the energy through boiler for this some equation and some formula applied on boiler to perform well and utilized more power and reduce losses on the boiler. For west solid material find some mega city to perform well [5].

In researcher's research analysis of energy and exergy for natural gas for fire boiler to perform. Some equation is made to boiler and its component. In boiler some energy is loss due to heat loss for study of this the losses in boiler energy loss is 16.81% and exergy loss is 6.14% [6]. A thermodynamic analysis of critical boiler and turbine for coal fire power plant. Energy and exergy is found in system and study that the plant is under various operating condition, different pressure and

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temperature and flow rate and define operating performance and efficiency [7]. The main source of generate the power in India is thermal and 65% of power in India is produce by thermal power plant. Technical availability and reliability and strategy of maintenance is required. The study of it said that current operating efficiency and loses of the boiler and can find big problem and its cause of heat loss by fault tree analysis (FTA) [8]. The energy generates and that energy is saving is most important factor and most of country is face this challenge. Energy and exergy utilization is saving the boiler efficiency and concern the major problem affected in boiler and production chamber is most important in steam generator turbine. So, in study of that combustion chamber's efficiency found that 55.4% [9]. For use west metal and generate the steam and in other country it can be use this method and generate steam with good efficiency the study is open literature to how it can be beneficial for society and how it can be reduced loses in this system to get more efficiency [10]. The study of calculating efficiency of boiler is important aspect in performance measurement in steam power plant and thermal power plant is convert coal energy to electrical energy. The main focus on boiler performance and its efficiency [11]. The combination of two boiler's main motive is heating in residential areas. The investigation and development of this boiler is acceleration and its main motive is increase limitation in view of the thermodynamics. In this the advance exergy analysis is concern and find improvement in potential in combination boiler [12]. In engineering application many boilers are used for their application and their use. In this many problem are come regarding a losses of boiler efficiency that's why study about the various problem and its with suitable solution [13].

III. BASIC PRINCIPLE OF BOILER

A boiler is closed vessel in which liquid is heated and convert into steam. In boiler for power produce is from use of fossil fuel and main source is natural gas or coal. In some other cases carbon monoxide is use for produce the power. There are many types of boiler. In this paper we focus only water tube boiler. A simple boiler is seen in fig. to understand very well a boiler can be made of steel but some boiler is made of the wall of bricks.

Fig. 1. A simple steam boiler[14]

VI. BASIC CONCEPT OF WATER TUBE BOILER

A water tube boiler is one type of boiler. In this water is circulate in tubes and heated outwardly by the fire, fuel is burn inside the furnace and make hot gases which can heat water and generate the steam or gas. A simple water tube boiler is seen in fig.

There are many sub type of water tube boiler like horizontal straight tube boiler, bent tube boiler and cyclone fired boiler and Babcock-Wilcox boiler.

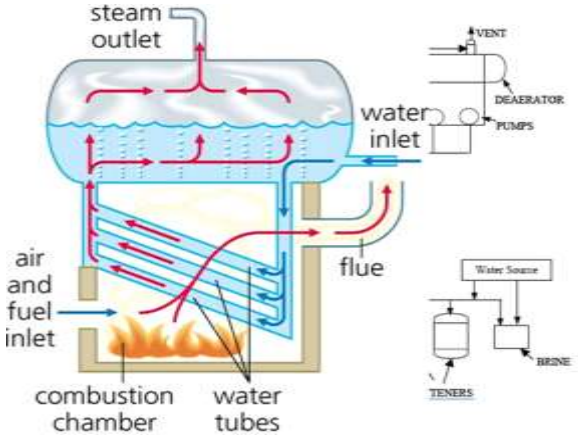

Fig. 2. A Simple water tube boiler[15]

Many researchers research and study about to how to increase efficiency in boiler and how to neglects the other things to boiler is perform well. In this paper study about the losses and problem of water tube boiler and make suitable solution of it. If we focus on major problem and their solution than efficiency will be automatically change.

Example: one boiler is work on their regular time period and get efficiency 60% of total input and 40% is losses in boiler. If we focus on that losses of 40% and find that the what is problem to loss 40%. In that maximum solution of that problems and make minimum losses on boiler so we can get at list 5 to 10% reduce the losses in boiler. So, we get 65 to 70% of efficiency of boiler.

So, in this paper discuss the major and minor problems of water tube boiler and will get highest efficiency in boiler.

V. OPPORTUNITIES OF GET HIGH ENERGY EFFICIENCY

Many energy efficiency opportunities in boiler to getting high efficiency.

1. Stack temperature control
2. Use economizer to feed water preheating
3. Combustion air pre-heating
4. Incomplete combustion minimization
5. Excess air control
6. Ignore radiation and convection heat loss
7. Blow down control
8. Decreasing of scaling and soot losses

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9. Decreasing of steam pressure of boiler
10. Various speed control for fans, blowers and pumps
11. Control boiler loading
12. Right boiler scheduling
13. Replacement of boiler

VI. MAJOR CAUSES IN WATER TUBE BOILER AND SOLUTION

In water tube boiler many minor and major problem are there but in this paper focus on that problem that can be affected in boiler performance and their efficiency. Some common boilers problem is discussing in below.

1. Boiler leaking
2. Low boiler pressure
3. Noisy boiler
4. Hot water or not heating
5. Radiator Fault
6. Frozen condensate pipe
7. Boiler not responding to thermostat
8. Water is doesn't heat
9. Pilot light keeps turning off
10. No power to boiler
11. Corrosion
12. Bubble formation
13. Agglomeration
14. Slagging
15. Fouling
16. Caustic embrittlement
17. Fatigue Failure

A. Boiler leaking

In some time, valve is loose or some high pressure this problem can happen. Water or gas are leaks continued so efficiency is losing. This fault is seen like small but if this is not solving than this is affected more in boiler.

Fig. 3. Leakage of boiler tube[16]

Possible solution for boiler leaking

Can checked in some specified time and can check tubes and outside the boiler and can check water tank.

B. LOW PRESSURE BOILER

Its cause by the leak of water or steam. If in boilers tube bend or leak anywhere than pressure can change. That change in pressure can be seen in pressure gauge. Water leaks create a hole in a boiler's components and get loss in pressure.

Possible solution of low pressure boiler

Find the which place leakage is come. When find the tube or any other component can have repaired or replace.

C. Noise in boiler

If boiler can noisy that is sign of any problem it can be overheating or any component failed and boilers life cycle goes on that is major cause of boiler that can be reduced possible as much time.

Possible solution of noise in boiler

Regular maintenance is solution of this problem. Boiler can be clean and maintain in their schedule time period.

D. Corrosion in boiler

Corrosion is cause of the reaction of metal with contact with the oxygen. Corrosion come in feed water as result of low pH water a present of diffuse oxygen and carbon dioxide. Corrosion is major problem in boiler. Fig. saw the corrosion in boiler.

Corrosion come when iron is contact with chemical reaction. Many type of corrosion are present in boiler like pitting corrosion, crevice corrosion, galvanic corrosion, caustic corrosion.

How to control corrosion in boiler

Corrosion is not gone permanently but it can be control. Change the regular pH in water and temperature of feed water tank. Checked system regularly for leaks and checked any signal of corrosion. Proper removal of gasses and feed water in tank. Regular checked of boiler will give clean and clear boiler.

Fig. 4. Corrosion effect in boiler[16]

E. Bubble formation in boiler or Foaming

A layer of bubble on the surface of water is call foaming. The cause of this happen is add many chemicals on boilers water like alkalis and oil and solid element in boiling water. These two elements are contact with each other and react and in this

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low the surface tension and high the foaming. Used lubricant in boiler this is initial origin beyond foaming.

Fig. 5. Bubble formation in boiler[16]

Solution of foaming in boiler
Use castor as anti-foaming oil. This is offset the effect of surface tension. Entry of the water is get right water treatment. Add aluminates sodium in water is good way to remove oil drop in boiler.

F. Agglomeration in boiler
It is ash generated problem that come in adhesive ash attach with the alkali loading and combustion temperature. The molecule of the sand is insert with and get large molecule is called agglomerates.

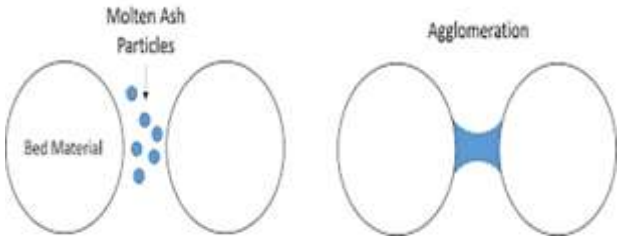

Fig. 6. Agglomeration makes in boiler[17]

Solution of Agglomeration –
Add Sulphur, kaolin and ammonia soleplate in water to reduce agglomeration on heated tube.

G. Slagging and Fouling in boiler
Evolution of element fused deposits in furnace walls is called slagging and define the deposits in furnace walls is called fouling. Ash is the main factor to form slagging and fouling in furnace walls.

Fig. 7. slagging [18]

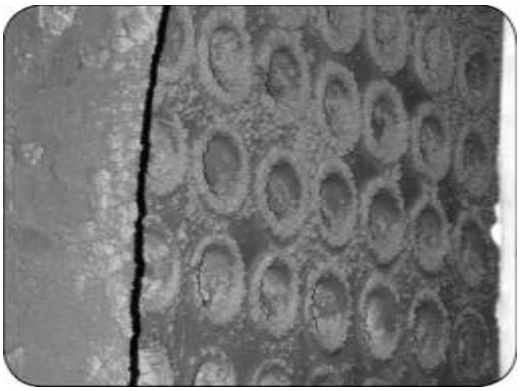

Fig. 8. 8 Fouling[18]

When ash particles are not cooled down that time slag is take place. If the furnace area is so small than the exit of temperature is rise and point of melting is low. So, melted ash doesn't time to cooled down that is the main reason of slagging.
Vaporization of volatile inorganic element or particles in the coal during combustion this is cause of fouling in furnace of the boiler.

Possible solution of Slagging and Fouling-
The process of slagging and fouling can't avoid permanently. It can be reduced and many ways to reduced it like ensuring distribution of heat to keep away from localization of temperature. Adding some conditioning in melted ash particles to cooled down furnace.
Pulse detonation wave technique, anti-fouling coatings, clever soot blower and chemical treatment technique etc. are processed to reduce in fouling in furnace of boiler.

H. Fatigue in Boiler Tubes
Fatigue is happening when continuous repeated cyclic process is done that time fatigue is occur in tube of boiler. Most of tubes are failed due to this problem. In survey of every boiler 80% tubes are failed due to fatigue. It is occurred when stress of material is lower than yield point of material.

Possible solution of Fatigue of boiler tube

Minimize stress concentration, pay attention when cycle is repeated and when cycle is start. Using good and capable material to sustain loan during boiler is working. Getting good surface finisher, monitor temperature variation, rising symmetry. If focuses on this factor while boiler is working than reducing in fatigue in tube of boiler.

VII. CONCLUSION

In this paper study about the losses on the boiler and get suitable solution of it. So, in this focus on the major problem like corrosion, foaming or bubble formation, leakage of boiler, and low pressure of boiler. If we study on how to efficiency will increase and it will be do but some losses in energy and efficiency. We can't use maximum efficiency and energy. So, in that losses we can reduce more in that by study on it to what is major problem and what is their solution to get more efficiency or energy. We conclude in this paper in study of problem than find best solution. We increase 5% to 10% of energy and efficiency of boiler without mathematics formula and calculation.

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