



REVIEW ANALYSIS ON BOILER EFFICIENCY AND DIFFERENT ENERGY LOSSES OF INDUSTRIAL BOILERS

¹Nishadevi N. Jadeja, ²Padhiyar Jitendrasinh, ³Vavdiya Babubhai A, ⁴Chaudhri Ankit

¹Assistant Professor, Mechanical Engineering Department, Government Engineering college Bhavnagar, Gujrat.

^{2,3,4}Mechanical Engineering Department, Government Engineering college, Bhavnagar, Gujrat.

ABSTRACT: Now a days most of modern chemical industries have packaged type boilers also they are using three pass and combined type water tube and fire tube type boilers. Generally when boiler run according to load capacity which is designed by industry, losses are comes out from it will also high so with calculating these losses we can improve efficiency of boiler by selecting different methods which are given by different authors below and choose any suitable method and can implement it in industry. But after some time the efficiency of the boiler decreased. And implementation of these kind of boiler also became difficult due to continuous working process. Only direct method is not sufficient for solving this problem, so indirect method also applied by technical approach.

[1] Ratchaphon Suntivarakorna and Wasakorn Treedetb

This research was conducted to improve the efficiency of a fire tube boiler with a fixed gate and screw conveyor for feeding fuel. The efficiency improvement was based on the use of flue gas heat for fuel drying, air preheating before combustion, and controlling amount of air for fuel combustion before entering the combustion chamber using the fuzzy logic control algorithm. The experimental result indicates that using heat recovery and fuel drying reduces 3%wt of fuel moisture content and boiler efficiency increases 0.41%. Preheating air means a 35°C increase of temperature or a 0.72% increase of boiler efficiency. The average accuracy of air control is 89.15%, indicating a 4.34% increase of boiler efficiency. If the three systems are operated simultaneously, 5.15% increase of boiler efficiency will be achieved or 246.88 tons/year saving of fuel.

[2] A WIENESE

This paper describes the modern boilers in the South African sugar industry. A new equation for the calculation of the net calorific value (NCV) of bagasse is suggested and a distinction is made between boiler design efficiency and boiler operation efficiency. Methods to calculate fuel calorific values and boiler efficiency from first principles are presented.

[3] Pachaiyappan R, J Dasa Prakash

Air pre-heater and economizer are heat transfer surfaces in which air temperature and water temperature are raised by transferring heat from other media such as flue gas. Hot air is necessary for rapid combustion in the furnace and also for drying coal in milling plants. So an essential boiler accessory which serves this purpose is air pre-heater. This paper deals with the different ways to obtain the maximum heat from the flue gas travelling through the air pre-heater and the economizer zone to improve the boiler efficiency. In this paper the performance of the air pre-heater has been studied on the basis of the combustion air passing through it. The correct optimization of the combustion air can increase the boiler efficiency by 2-3%. It also ensures less fuel consumption. By reducing the air pre-heater leakage the auxiliary power consumption is also reduced. Thus the fuel is saved which leads to a considerable amount of profit.

[4] K. Sampath Kumar Reddy, Dr B. Veerabhadra Reddy

The power sector is one of the sectors of the India's economy. The development of the country to a large extent is dependent on the growth of this sector. Through the progress of the power sector during the past four decades has been sustainable, the power industry has been unable to fulfill primary obligation of production quality power supply in required quantity. The CFD model may be used to optimize its thermal performance by varying the location in the economizer and in turn improve the performance of boiler. And due to changing the material of economizer such as mild steel. Outlet pressure of the economizer is increased and temperature is not varied but velocity is decreased due to using the mild steel. Finally the boiler efficiency is increased.

[5] Vikram Singh Meena, Dr. M.P Singh

Performance as boiler efficiency and evaporation ratio decreases with time due to poor operation poor combustion, heat transfer fouling and poor combustion and maintenance. A deteriorating fuel quality and water quality also leads to poor performance of the boiler. Efficiency tests help us to know what the efficiency of the boiler is far from the best efficiency. So

we can increase efficiency of boiler by increasing pressure or temperature or both of steam by providing more coal flow rate or coal with grosser calorific value. But these two should be such that is balance cost with design cost.

[6] M.N. LAKHOVA

The aim of this paper is to present the functionality of a thermal power plant, on the one hand, and the boiler efficiency calculations, on the other hand. This is why we present a stratification survey by circuit, by equipment and by organ with the objective is to determine the possible reasons of the deterioration of the plant heat rate. This survey concerns particularly the application of the causal analysis in order to determine the different losses at the level of the boiler of a thermal power plant. In this paper, we presented an exploration of the ways permitting the improvement of the plant heat rate. This is why we present two methods for the boiler efficiency calculations on the one hand and an analysis of the different losses at the level the boiler using the causal analysis, on the other hand. Calculating the boiler efficiency by the Input Output method is desirable because of the simplicity of the method but is subject to the inaccuracies of all of the measurements needed. The method of heat losses increases the accuracy of the calculation but, while the number of measurements is decreased, the difficulty of obtaining accurate measurements is increased. Finally, it important to determine the possible causes generating the losses and provoking the deterioration of the plant heat rate while using the causal analysis.

[7] Marc Compton and Behnaz Rezaie

An investigation, based on the second law of exergy, of the boilers at the UI district energy plant has been conducted. Four different boilers, each with different configurations, are evaluated and the thermal and exergy efficiency of each is compared. Energy efficiency varies from 76 to 85%, while exergy efficiency is significantly lower at 24 to 27%. Much of the reduced exergy efficiency for both fuel types is due to the exergy destroyed during the combustion process, an unavoidable characteristic of combusting fuel. The reduced heating value of the wood chip fuel is the primary cause for the reduced efficiency when compared to natural gas, however the proximity of the fuel source still results in substantial economic savings and increases the sustainability footprint of the school thanks to reduced transportation costs. This minimizes the ancillary emissions created by regular shipments of wood chips delivered by trucks.

[8] Rahul Gupta

In this paper, the findings of boiler house efficiency improvement study carried out in a large boiler house unit of a pulp and paper mill has been presented. The causes of poor boiler efficiency were various heat losses such as loss due to unburnt carbon in refuse, loss due to dry flue gas, loss due to moisture in fuel, loss due to radiation, loss due to blow down, and loss due to burning hydrogen, etc. The various heat losses were analyzed and a set of recommendations were made to the plant management for implementation, so that efficiency of boiler can be increased. Five important recommendations were implemented by plant management, and it has been seen that there is tremendous increase in boiler efficiency. This work determines and concludes that, tremendous positive gains can be attained by employing above approach in a given energy intensive activity, in this case in boiler house of a large paper mill. Overall boiler efficiency on account of all improvement recommendations has increased by 2% from 80.98% to 82.98%, which is a remarkable increase given the facts that no new equipment has replaced old boiler house equipment. This increase in efficiency speaks volumes about use of energy management which is need of hour and this will lead to an economy with higher productivity and sustained growth.

[9] Mr.Swapnil V. Charde¹, Mr.Sanket G.Bhoyar, Mr.Harshal R. Sonkusre, Mr.sagar M.Nakade Asst.Prof. Hitesh Bisen

Thermal power plant converts the chemical energy of the coal into electricity. The heat rate of a conventional coal fired power plant is a measure of how efficiently it converts the chemical energy contained in the fuel into electrical energy. Coal fired Boiler is one of the most important components for any Thermal Power Plant. The aim of monitoring boiler performance is to control the heat rate of plant. The world over energy resources are getting scarcer and increasingly exorbitant with time. The objective of the study was to analyze the overall efficiency and the thermodynamic analysis of boiler. There are many factors, which are influencing the performance of the boiler. Heat rate is increases as boiler efficiency decreases so to achieve desired heat rate boiler performance required to be improved. Boiler efficiency is improved by reducing various losses and controlling stack temperature.

[10] Acharya Chirag, Prof. Nirvesh Mehta, Prof. Jaspal Dabhi

This paper is concerned with calculating boiler efficiency as one of the most important types of performance measurement in any steam power plant. Thermal power plant converts the chemical energy of the coal into electricity. The heat rate of a conventional coal fired power plant is a measure of how efficiently it converts the chemical energy contained in the fuel into electrical energy Heat rate is expressed as kcal/kwh. The aim of monitoring boiler performance is to control the heat rate of plant. This paper deals with determination of operating efficiency of Boiler and calculates major losses for GSECL 210 MW unit in India. Thermal power plant heat rate is directly affected by boiler efficiency. From calculation it is found that 1%

decrease in boiler efficiency increases the heat rate by 1%. Heat rate increases as boiler efficiency decreases so to achieve desired heat rate boiler performance required to be improved. Boiler efficiency is improved by reducing various losses and controlling stack temperature.

[11] Sangeeth G.S., Praveen Marathur

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. The objective of the study was to analyze the overall efficiency and the thermodynamic analysis of boiler. There are many factors, which are influencing the efficiency of the boiler. The fuel used for combustion, type of boiler, varying load, power plant age, heat exchanger fouling they lose efficiency. The paper set to show the weakness of depending on energy analysis only boilers as a performance measure that will help improve efficiency.

[12] Arunesh Kumar, Abhishek Arya and Rahul Kumar Singh

The main motive of this study is to identify maximum energy loss areas in any thermal power stations and generate a plan to reduce them using energy and exergy analysis as the tools. The energy sources are decreasing down day by day around the world due to the growing demand and sometimes due to ageing of machinery. This paper shows the innovative ideas to reduce losses of boiler and improve boiler efficiency by using the variation of boiler load and also percentage of excess air. We conclude the following point which points show in paper and by using of heat balance sheet clearly indicate unnecessary loss of heat. Give some ideas to reduce unnecessary losses and improve boiler efficiency.

[13] Chayalakshmi C. L., D.S. Jangamshetti, Savita Solanki

Data Acquisition System Laboratory (DASY Lab) software was used to estimate energy losses in boiler. Direct method of evaluating the boiler efficiency is simpler but does not provide any information about boiler losses. Calculation of boiler efficiency using indirect method is time consuming. The software eliminates time consuming calculation for boiler engineers and the control action can be initiated immediately, which reduces the fuel consumption.

[14] Mr. Bhavesh Jinjala, Prof. Rashmikant, N. Shukla

This paper represents industrial energy use can also be reduced using variable speed drive in motor operated system, high efficient motors, like efficient nozzles in compressed air system. By HP of motor increases, the energy saving also increases and also VSD installation can help in controlling of control excess air and stack temperature.

[15] Tai LV, Linghao Yu, Jinmin Song

Analysis of coal when testing boiler efficiency by traditional method, it is so costly. However it is much easier to make proximate analysis of coal, a mathematic model of coal has been established. In boiler efficiency testing, theoretical air requirement, heat loss due to exhaust gas and heat loss due to unburnt gases when compared by this new model. Errors are no more than 5%.

[16] Nabil M. Muhaisen, Rajab Abdullah Hokoma

This paper is concerned with calculating boiler efficiency as one of the most important types of performance measurements in any steam power plant. That has a key role in determining the overall effectiveness of the whole system within the power station. The calculation of the boiler efficiency was applied by using heating balance method. The findings showed how the maximum heat energy which produced from the boiler increases the boiler efficiency through increasing the temperature of the feed water, and decreasing the exhaust temperature along with humidity levels of the fuel used within the boiler.

[17] P. Ravindra Kumar, V. R. Raju, N. Ravi Kumar, Ch. V. Krishna

The major efficiency loss of a boiler is caused by the hot stack gases discharging to the atmosphere which is polluting the atmosphere and on other side Pollution Control Board is forcing the norms of Pollution levels in atmosphere. One of the most cost-effective ways of improving the efficiency of a high pressure steam boiler is to install an economizer on the boiler. Typically, on a high pressure water tube boiler, the efficiency improvement with an economizer is 2 to 4%, depending on firing rate. On a high pressure fire tube boiler, the improvement is 2 to 3.5%, depending on boiler size and firing rate. The economizers are located in the boiler stack close to the stack gas outlet of the boiler. Finally a comparison of efficiencies of the boiler is made between the existing unit and the unit when additional bank of tubes are assumed both for subcritical and Supercritical operating parameters mode. At last, various pros and cons have been found out by conducting above investigation i.e. by incorporating additional bank of tubes in the economizer.

[18]Krishan Kumar, Dharmendra Patel, Vinod Sehravat, Tarun Gupta

Exergy analysis has sparked interest within the scientific community to require a more in-depth check up on the energy conversation devices and to develop new techniques to rise utilize the prevailing restricted resources. Exergy analysis gives entropy generation, irreversibility percentage exergy loss and second law efficiency. In the present work a exergy analysis of operating condition of boiler has been carried out based on mass and exergy balance.. It has been found that maximum exergy destruction occurs due to combustion process. Also there is significant exergy destruction occurs in the boiler pressure parts.

COCLUSION:

- (1)The objective of the study was to analyze the overall efficiency and the thermodynamic analysis of boiler. There are many factors, which are influencing the performance of the boiler. Heat rate is increases as boiler efficiency decreases so to achieve desired heat rate boiler performance required to be improved.
- (2) In this paper the performance of the air preheater has been studied on the basis of the combustion air passing through it. The correct optimization of the combustion air can increase the boiler efficiency by 2-3%. It also ensures less fuel consumption. By reducing the air preheater leakage the auxiliary power consumption is also reduced. Thus the fuel is saved which leads to a considerable amount of profit.
- (3)Exergy analysis gives entropy generation, irreversibility percentage exergy loss and second law efficiency. The exergy loss or irreversibility is maximum at boiler. Thus to know about actual flow of exergy in the cycle thermodynamic analysis based on second law is desirable.
- (4)In this paper, we presented an exploration of the ways permitting the improvement of the plant heat rate. This is why we present two methods for the boiler efficiency calculations on the one hand and an analysis of the different losses at the level the boiler using the causal analysis, on the other hand. Calculating the boiler efficiency by the Input-Output method is desirable because of the simplicity of the method but is subject to the inaccuracies of all of the measurements needed. The method of heat losses increases the accuracy of the calculation but, while the number of measurements is decreased, the difficulty of obtaining accurate measurements is increased. Finally, it important to determine the possible causes generating the losses and provoking the deterioration of the plant heat rate while using the causal analysis. By energy audit we can calculate energy losses from different components in industry. Boiler efficiency can be easily calculated by direct method but this method can not help us to calculate losses from heating elements like air-preheater, condensor, steam boiler, heat exchanger. With the help of indirect method can easily calculate different losses. We can reduce losses from furnace by providing proper insulation another method is also useful to us like by selecting proper speed and gear drive , by use proper quality of fuel supply also can maintained by size of fuel so it can improve proper rate of combustion also.

References:

- [1]Ratchaphon Suntivarakorn and Wasakorn Treedetb "Improvement of Boiler's Efficiency Using Heat Recovery and Automatic Combustion Control System" 3rd International Conference on Power and Energy Systems Engineering, CPESE 2016, 8-12 September 2016, Kitakyushu, Japan
- [2] A WIENESE "BOILERS, BOILER FUEL AND BOILER EFFICIENCY" Sugar Milling Research Institute, Durban 4041, South Africa
- [3] Pachaiyappan R, J Dasa Prakash "Improving the Boiler Efficiency by Optimizing the Combustion Air" Applied Mechanics and Materials Vol. 787 (2015) pp 238-242 Submitted: 2015-02-05 © (2015) Trans Tech Publications, Switzerland Revised: 2015-03-23 doi:10.4028/www.scientific.net/AMM.787.238
- [4]K. Sampath Kumar Reddy, Dr B. Veerabhadra Reddy "Performance of the Boiler and To Improving the Boiler Efficiency" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 8, Issue 6 (Sep. - Oct. 2013), PP 25-29 www.iosrjournals.org Using Cfd Modeling
- [5] Vikram Singh Meena, Dr. M.P Singh "Efficiency Assessment and Improvement of Boiler at Super Thermal Power Station" INTERNATIONAL JOURNAL FOR ADVANCE RESEARCH IN ENGINEERING AND TECHNOLOGY
- [6] M.N. LAKHOUE "CAUSAL ANALYSIS AND BOILER EFFICIENCY CALCULATIONS OF A THERMAL POWER PLANT" Laboratory of Analysis, Design and Command of Systems (LACS) ENIT, BP 37, Le Belvedere, 1002 Tunis, Tunisia
- [7] Marc Compton and Behnaz Rezaie "Sustainability Enhancement of a Biomass Boiler through Exergy Analysis" Applied Energy Research Laboratory (AERL), Department of Mechanical Engineering, College of Engineering, University of Idaho, 875 Perimeter Dr., Moscow, ID 83844-0902, USA; rezaie@uidaho.edu Correspondence: comp8033@vandals.uidaho.edu

- [8] Rahul Gupta "Energy Efficiency Improvement Strategies for Industrial Boilers: A Case Study" Department of Mechanical Engineering, M.M. Engineering College, Mullana, (Ambala), 1 Centre of Energy Studies, Indian Institute of Technology, Delhi, 2 Department of Mechanical Engineering, National Institute of Technology, Kurukshetra, India
- [9] Mr.Swapnil V. Charde¹, Mr.Sanket G.Bhoyar, Mr.HarshalR. Sonkusre, Mr.sagar M.Nakade Asst.Prof. Hitesh Bisen "CASE STUDY ON EFFICIENCY OF BOILER AND FACTORS AFFECTING IT" International Journal on Research & Modern Trends in Engineering & Management (IJRMTEM) Vol. 2, Issue1, March 2017
- [10] Acharya Chirag, Prof. Nirvesh Mehta, Prof. Jaspal Dabhi "Research paper on Analysis of Boiler losses to improve Unit heat rate of coal fired thermal power plant." International Journal of Advance Engineering and Research Development (IJAERD) Volume 1, Issue 5, May 2014, e-ISSN: 2348 - 4470 , print-ISSN: 2348-6406
- [11] Sangeeth G.S., Praveen Marathu " EFFICIENCY IMPROVEMENT OF BOILERS" 1 PG Scholar, Energy Systems, Nehru College of Engg & Research Centre, Kerala, India 2 Assistant Professor, Mechanical Department ,Nehru College of Engineering & Research Centre, Kerala, India
- [12] Arunesh Kumar, Abhishek Arya and Rahul Kumar Singh VARIATION OF BOILER EFFICIENCY WITH RESPECT TO BOILER LOADS BY INCREASING OF EXCESS AIR ISSN 2319-5991 www.ijerst.com Vol. 3, No. 4, November 2014 © 2014 IJERST. All Rights Reserved.
- [13] Chayalakshmi c. L., D.S. Jangamshetti, Savita Solanki
- [14] Mr. Bhavesh Jinjala, Prof. Rashmikant , N. Shukla
- [15] Tai LV, Linghao Yu, Jinmin Song
- [16] Nabil M. Muhaisen, Rajab Abdullah Hokoma
- [17] P. Ravindra Kumar, V .R .Raju, N .Ravi Kumar, Ch. V. Krishna
- [18] Krishan Kumar, Dharmendra Patel, Vinod Sehravat, Tarun Gupta