Exergy Analysis of CFBC Boiler over AFBC Boiler by Using Textile Waste as a Primary Fuel - A Review

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Abstract — The main motive of this study is to analysis of Atmospheric fluidized bed combustion boiler and Circulating fluidized bed combustion boiler and generate a plan to reduce the maximum loss areas by using exergy analysis. For this analysis, conduct energy calculation of the overall plant and determine the efficiencies and energy losses of all the major components of the thermal power station. Then find out those areas where energy losses are occurring maximum and then compare them by using heat balance sheet for efficient and effective improvement in thermal power station. The study was carried out at Thermal power station of Yarns Industry at Mandideep and boiler section of thermal power plant is considered for the purpose of exergy analysis. The boiler of a power plant is the most effective section in eliminating exergy. The results show that boiler losses and boiler efficiency depend on boiler load and percentage of excess air.

Keywords: Boiler Efficiency of AFBC and CFBCs, Textile Waste, Exergy Analysis, Efficiency Difference, Comparison, Heat Balance Sheet

I. INTRODUCTION

The Rankine power cycle which changes over the nuclear power into mechanical energy, doesn't contrast between basic, sub-basic, supercritical, ultra-supercritical and high level ultra-supercritical cycles. Energy can nor be made nor obliterated. It simply changes structures like potential, substance, electrical energy, intensity and work. Energy investigation in light of the primary law of thermodynamics exemplifies the standard of protection of energy and is the customary technique used to survey the exhibition and productivity of the energy frameworks and cycles. The word 'Exergy' was gotten from Greek words ex (significance out) and ergon (importance work). Exergy is the valuable work capability of the energy. Exergy isn't moderated. Once the exergy is squandered, it can never be recuperated. At the point when we use energy we are not obliterating any energy; we are just switching it over completely to a less valuable structure, a type of less exergy. The valuable work capability of a framework is how much energy we remove as helpful work. The valuable work capability of a framework at the predefined state is called exergy.

(Likewise called accessibility or exergy). Exergy is a property and is related with the condition of the framework and the climate Exergy misfortunes are added substance (i.e the complete exergy misfortune for the plant is the amount of all the part misfortunes), empowering attribution of the misfortunes to establish parts. Exergy is constantly obliterated when an interaction includes a temperature change. This annihilation is relative to the entropy increment of the framework along with its environmental factors. Second regulation examination is tied in with grasping irreversibility in frameworks. It centers around changes in the nature of energy. The nature of energy is estimated by exergy. As energy is utilized in a cycle it loses quality and its exergy diminishes. There can't be an "energy emergency" as energy is constantly preserved. A framework that is in harmony with its environmental factors has zero exergy and is supposed to be at the dead state. At the dead express, a framework is at the temperature and tension of its current circumstance and it has no motor or potential energy comparative with the climate. As a matter of fact gouy and stodola freely showed that the outright worth of this deficiency of exergy is equivalent to the entropy creation duplicated with the temperature of the environmental elements. The exergy investigation is an instrument to distinguish misfortunes and obliterations so that suitable measures can be executed to decrease the misfortunes and obliterations. An exergy examination is an extremely strong approach to improving complex thermodynamic frameworks.

Exergy examination helps in further developing plant effectiveness by deciding the beginning of exergy misfortunes, and subsequently giving a clearer picture. Exergy help in distinguishing parts where high failures happen, and where enhancements are justified, the thermodynamic cycle can frequently be upgraded by limiting the irreversibility's.

Chetan T. Patel, Dr. Bhavesh K. Patel, Vijay K. Patel, they had working out proficiency of FBC evaporator. The numerical model in the Microsoft succeed is ready for the roundabout technique for tracking down evaporator proficiency, in light of the fact that these strategies has a load of estimation which make us a drag in the event that a similar computation is expected for the different worth of GCV of coal. By utilizing Microsoft succeed the rehashed estimations are by and large very simple and efficient. Simply change the different qualities and at the last you came by the outcome promptly with no transcribed tedious administrative work.

P.K. Pester made sense of the investigation of coal. As per this book the coal investigation is of two kinds, for example,

1) Ultimate Investigation
2) Proximate Investigation

General investigation and extreme examination; both done on a mass percent basis. Both these sorts might be founded on

1) As-got premise valuable for burning computation,
2) Dry or dampness free premise
3) Dry mineral sans matter premise.

As indicated by this general investigation of coal gives the data of FC, VM, M, debris, and so on. Furthermore, the opposite side a definitive investigation gives the data about the synthetic components that involve the coal substance along with debris and dampness

II. LITERATURE REVIEW

Literature review is part of discussion of different author's paper comparatively. In this paper we discussed about the boiler efficiency calculation and find out the better result to improve boiler efficiency and also, we discussed about what the authors states.

Rahul Dev Gupta and Sudhir Gupta, 2011 is doing case study on "Energy efficiency improvement strategies for industrial boiler". Here result shows that by controlling excess air boiler efficiency improved from 80.98% to 81.94%. So, this work determines that overall boiler efficiency on account of all improvement recommendation has increased by 2% from 80.98% to 82.98%.

Amir Vosough, 2011 define "Improvement Power Plant Efficiency with Condenser Pressure". The analyses show that the condenser pressure is an important parameter that affects the output power, power potential and thermal and exergy efficiency of the cycle. The maximum energy loss was found in the condenser where 60.86% of the input energy was lost to the environment. The calculated thermal and exergy efficiency of the power cycle was found to be 38.39%, 45.85 %.

Chetan T. Patel, 2013 conducted research on "Efficiency with different GCV of coal and efficiency improvement opportunity in boiler". He derived conclusion from this paper are if higher GCV coal is used, then the efficiency should be increased. Ash and Moisture content inside the fuel will affect the efficiency. By using semi bituminous coal efficiency is 80.20% because of its high heating value and less moisture and ash content, while Indian lignite coal gives 77.51% efficiency on the same boiler because of it has a more ash and moisture contents than the semi bituminous coal.

Acharya Chirag, 2014 define analysis of "Boiler losses to improve unit heat rate of coal fired thermal power plant". It is conducted at 210 MW power plant by Direct and Indirect method. The result of this paper shows that thermal power plant heat rate is directly affected by boiler efficiency. From calculation it found that 1% decrease in boiler efficiency increases the heat rate by 1%. Heat rate is increases as boiler efficiency decreases.

Moni Kuntal Bora, 2014 carried out "Performance Analysis from the Efficiency Estimation of Coal Fired Boiler". This paper puts forward an effective methodology for the efficiency estimation of a coal fired boiler, comparison with its design value and enlists some of the factors that affect the performance of a boiler.

Sangeeth G.S., 2015 shows the "Efficiency improvement of boilers" in his research. The objective of the study was to analyze the overall efficiency and the thermodynamic analysis of boiler. It is noticed that the overall efficiency of any boiler depends upon the technical difficulties under unpredictable conditions. 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.

J. Suresh babu, 2015 project objective is to analyze the efficiency of economizer, super heater and air pre-heater by varying the various parameters in boiler section. He is concluded that by installing the economizer in the plant in the plant, the plant efficiency can increase by 10% and by implementing the super heater the efficiency can be increased by (25 - 30) %, (8-10) % in each stage of super heater.

Sarang j gulhane, 2015 carried out their research on "Scope and energy losses minimizes in the AFBC boiler". Here he finds out result after discussion on paper is if we increase load then losses is reduced so plant should be run in the peak load, in 5.6 MW the boiler efficiency is 83.03% and 1.1 mw it was 76.63%.

Rakesh Kumar Sahu, 2015 define as "Energy Performance Assessment of CFBC Boiler". This project is done at 150 MW. Conclusion derived from the data related to the boiler, if higher GCV coal is used, then the efficiency should be increased and the other one is the excess air. The quantity of excess air needs to be optimized for achieving maximum efficiency of boiler.

III. PROBLEM IDENTIFICATION

This Exploration is hung on Industry yarn mandideep 30MW power plant Industry yarn is a textile organization. in this nuclear energy station Atmospheric Fluidized bed combustion boiler are used to producing steam. For creating Steam different kinds of Poor-quality fills are utilized. Air fluidized bed evaporator isn't able to consume different second-rate fuel and aftereffects of unborn carbon. For Complete Burning of second rate fills some overabundance Air is required which aftereffects of abatement kettle productivity and power age cast is expanded. This issue is overwhelmed by utilizing circulating fluidized bed combustion boiler in light of the fact that CFBC boiler is Reasonable for Different poor-quality fills. CFBC Evaporator give total burning of second-rate fuel without abundance air. This theory was authorized thus. The ideal extent of activity incorporates the accompanying things:

1) Similarity with extensive variety of energizes Customary Boilers for power age can utilize just petroleum products, like high grade coal, oil, and gas. The circling fluidized bed evaporator (CFBC) is likewise fit for utilizing low graduate coal, biomass, muck, squander plastics, and waste tires as fuel.
2) Low contamination NOX and SOX emanations are fundamentally diminished without exceptional ecological adjustments. In the event of fluidized bed boilers, desulfurization is completed intra heater, utilizing fundamentally limestone as the fluidized material. For denitration, PC boilers work at ignition temperatures from 14000C to 15000C; while Coursing fluidized bed boilers work at lower temperature, going from 8500C to 9000C, subsequently suppressing warm NOX emanations as the age of NOX is subject to the burning temperature. Furthermore, the activity of circling fluidized bed boilers includes a two-phase burning interaction: the diminishing ignition at the fluidized bed segment, and the oxidizing ignition at the free board segment. Then, the unburned carbon is gathered by a high - temperature twister situated at the evaporator exit to reuse to the kettle, consequently expanding the denitration productivity.
3) Space-saving, simplicity of support Space saving is accomplished on the grounds that there is no requirement

for independent desulfurization, denitration, and fine-fuel smashing units. Likewise, pain points are limited, and upkeep is streamlined.

4) High ignition productivity Further developed ignition productivity is accomplished using a coursing fluidization mode burning system.

IV. OBJECTIVES

So, following are objective of the proposed work:

- Calculate Calorific value of Textile waste with help of bomb calorimeter.
- Calculate losses with help of heat balance sheet
- Calculate the efficiency of AFBC AND CFBC BOILER by using indirect methods.
- By calculating all above-mentioned parameters, the overall objective of this dissertation is to exergy analysis of AFBC and CFBC boiler then compare for improvement of Boiler efficiency.

V. EXPECTED OUTCOME

This paper shows the enervative ideas to update working process of thermal power plant by using circulating fluidized bed combustion boiler which is suitable for low grade fuel like as textile waste and give maximum efficiency as compared to atmospheric fluidized bed combustion boiler. In this exergy analysis atmospheric fluidized bed combustion boiler give poor efficiency and more loses as compare to Circulating fluidized bed combustion boiler. Circulating fluidized bed combustion boiler also reduced emissions of harmful gases and unburn carbons.

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