A Review on Performance Comparison of Briquette Boiler & Furnace Boiler

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Abstract - Boiler is a complex system, whose combustion efficiency is of great significance for sustainable development of energy and economy. Boiler is a typically complex system which is multi-input, multi-output, nonlinear as well as non-self-balanced, and boiler combustion of power station is complex physical and chemical process. Therefore how to improve the combustion efficiency of natural gas boiler has always been an important issue in this field. The efficiency of a boiler system is important in several ways. Thus this work will provide the performance comparison of Briquette Boiler & Furnace Boiler of process industry and the ways to improve its efficiency. It will also provide study of boiler efficiency improvement by use of simulations in MATLAB.

Keywords- *Briquette Boiler, Furnace Oil Boiler, Boiler Efficiency, Process Industry etc.*

I. INTRODUCTION

Energy is the capacity to do work and work is the transfer of energy from one form to another form of energy. Energy sources are available as electrical, thermal, light, chemical, mechanical, solar, wind, tidal, nuclear energy and so on. The coal and the crude fuel are the major natural resources are meeting 85% of the society need which will deplete soon. The fundamental goal of energy management is to produce goods and provide services with the least cost and least environmental effect. The term energy management means many things to many people.

To achieve low carbon economy by saving energy is the trend of today's society. Boiler is a kind of common equipments with high energy consumption. At present, boiler efficiency is not high and a great deal of energy has been wasted seriously in China. The test of boiler efficiency is an effective way to identify boiler problems and improve its efficiency. Until 2008, the total number of using industrial boilers has been amounted to 578200 units. The traditional method to test boiler efficiency is time consuming and expensive, and the test of boiler efficiency needs ultimate analysis of fuel. However, the test of the ultimate analysis of fuel is in need of long time, and its related equipment is also more expensive.

A boiler is defined as "A closed vessel in which water or other liquid is heated, steam or vapor is generated, steam is superheated, or any combination thereof, under pressure or vacuum, for use external to itself, by the direct application of energy from the combustion of fuels, from electricity or nuclear energy". Boilers are considered to be as the key part in any generation station as it is the place where the fuel is used for producing the needed amount of heat. A boiler is an enclosed vessel that provides a means for combustion heat to be transferred to convert water into steam. A boiler is a complex integration of evaporator, re-heater, super heater, economizer, air pre heater along with various auxiliaries such as pulverizer, fans, etc. The purpose of the performance test of boiler is to determine actual performance and efficiency of the boiler and compare it with design values.

Figure 1: Boiler System

This paper presents related work in section II. Section III describes the components of boiler. Section IV presents the problem formulation of system. Then conclusion is presented in Section V.

II. RELATED WORK

J. Wang et al. [2014] [11] proposed Data-Driven Thermal Efficiency Modeling and Optimization for Co-ending boilers. The movements of stream rate and warming estimation of effect radiator gas (BFG) make the pot action more like workmanship than science. Estimations assessment systems were utilized to legitimize the significance of the construed elements for the warm

adequacy showing. The detail examination showed that there was enormous space for imperativeness security when the evaporator movement shifts from the present practice to the model-based control. The favorable position/cost extent is immense enough while considering no fixed cost is required in the execution of model-based control for this circumstance for any certified pot action.

Y. Liu A. et al [2015] [12] had proposed an essentialness examination of coursing fluidized bed evaporator. As demonstrated by the essentialness capability assessment of streaming fluidized bed (CFB) pot, diverse imperativeness setback rates occured. Start imperativeness hardship and warmth move essentialness adversity were the genuine incidents of CFB pot, speaking to over 45% of the fuel engineered essentialness by CFB radiator imperativeness examination procedure. To the degree CFB pot concerned, compound lacking consuming essentialness adversity rate and exuding imperativeness mishap rate were both excessively little to ever be unimportant. Unburned carbon essentialness hardship should be revolved around in view of its high imperativeness quality. CFB pot slag had a higher degree of coal ash. As such, he proposed it is fundamental to diminish the slag physical imperativeness disaster for improving CFB radiator profitability. CFB pot slag normally speaks to a higher degree of coal red hot garbage, so reducing slag physical essentialness disaster is vital to improve the CFB warmer efficiency.

Chayalakshmi C. L. et al. [2015] [13] proposed a speculation to evaluate radiator capability from hydrogen content in fuel. Since, Boilers and turbines are the most key parts in warm power plants; capable utilization of warmth essentialness conveyed from compound bit of fuel ensures overhauled control age. Execution degradation of radiator is generally a result of pot incidents. In this manner, this technique uses incident in view of hydrogen content in fuel and improves the methods in finding pot efficiency. The hydrogen substance of fuel, temperature of pipe gas, including temperature, and gross calorific estimation of fuel are used for finding the viability of radiator. The best screw up in envisioning the radiator viability is 1.82 %, which infers the validity of the proposed technique. The foreseen warmer capability is affirmed using data from an industry.

Bogdanov A.V et al. [2016] [14] displayed the program affirmation of a vague specialist in a control plan of TPS' steam evaporator for alteration of the PID-operator reliant on the definite term-sets. The convenient essentialness of the investigation work is being created of the movement time figuring of fuzzification of reliable physical sizes of inventive methodology of an evaporator and the square diagram of the officials of a steam pot as a superstructure above old style PID-operators with variable parts. The square outline of controlling system of expending and steam advancement is fabricated reliant on a game plan of age rules of the two-digit basis. Parameters of the quality and power profitability of the customized controlling a steam pot with an indistinct change of the PID-operator are displayed. The 3-D model of the leading group of expending and steam course of action frames in a steam evaporator has been made in the fluffy Tech's condition. The examination of a surface of the created model of the administrators is presented.

R. Manescu et al. [2016] [15] gave a decision to extend warming efficiency with various boilers. Building essentialness usage implies directly around 33% of the overall imperativeness use and most by far of that is used for structure warming and cooling. A close to report was performed on warming systems concerning the amount of falling boilers and the impact on warming profitability. Results show a 15% development in capability if there ought to emerge an event of various evaporator structures stood out from single radiator foundations. Result exhibited that in the cost capability thought, the two radiator systems were the most used for all intents and purposes anyway with our examinations the three boilers investigations are with the most raised yields. The cost of the foundation was higher yet usage of three boilers, their life saw to be longer and the threat of dissatisfaction was lower.

N. Magar et al. [2017] [16] proposed an Analysis of CFBC Boiler for Optimized Performance. Maker focused on the working of CFBC boilers and execution Improvement of the CFBC pot by adjusting the structure Parameters of the tornado separator. The arrangement of this tropical storm relies upon improving tornado viability by changing the channel estimations, growing the vortex length and decreasing the leave separation over. The purpose behind arrangement adjustment is to extend the aggregation profitability of the storm separator. Computational Fluid Dynamics (CFD) model is used for amusement. Results showed that gathering capability of the hurricane separator can be improved by growing the vortex pioneer length and modifying the channel estimations of the twister separator.

W. Wenbiao et al. [2017] [17] has proposed the usage of tremendous data in essentialness capability and weight evaluating of warming Boilers. The introduction the officials plan of evaporator involving colossal data organize, using gathering speculation by tremendous data to examination data for the boilers, to find principal segments impacting viability of boilers, and operational course and streamlining. In the meantime, the theory of information mining is familiar with foreseeing pile of boilers. Get astonishing bit of leeway of essentialness saving 9%, and to achieve the pot load course, the error of 1%.By applying immense data thinking to radiator improvement and heading, and mining variable information, this prompts the end that there have strong association between's warm adequacy and stack of boilers.

X. Wu et al. [2017] [18] proposed a cross breed least square help vector machine (LSSVM) to envision the evaporator consuming efficiency. In this strategy, a main part examination (PCA) was used to imitate new factors as the commitment of the farsighted model. By then, a particle swarm improvement (PSO) count upgraded LSSVM was proposed. The parameters of LSSVM were redesigned effectively by PSO and the yield estimation of the model is corrected to improve the conjecture accuracy. The preliminary outcomes subject to sensible educational assortment speak to that the proposed blend LSSVM showed signs of improvement precision differentiated and other data driven philosophies, for instance, the multilayer perceptron (MLP) and Elman neural framework. The proposed evaporator consuming capability model can meet the necessities of pot control and improvement.

Kazarinov L.S. et al. [2017] [19] proposed a profitability evaluation system for boilers execution with a gathering based breakdown of results. It contains general information about an automated course of action of regulating steam boilers at the power plant ended by a mix of force (fuel) gases with problematic traits. One of the features of this system is estimation and impression of the pointer for evaluation of the show of boilers capability with a gathering breakdown of results. The strategy of steam boilers capability appraisal has been prescribed. For the inspirations driving such evaluation, a general marker of effect warmer gas use has been displayed. The appraisal of capability is performed basing upon an assessment of the estimation of the proportion of calorific imperativeness coming into boilers with sway warmer gas during the reference time span with a similar marker for the noteworthy time period. This evaluation engages us to show the part of contention between bunches in the amassing strategy to extend usage of the discretionary imperativeness resources of a metallurgical works – sway warmer.

U. Hanifah et al. [2018] [20] had proposed an assessment on fuel use and essentialness adequacy at Soymilk Cooking Using a Mini Boiler and Using a Gas Stove. With the use of a tofu cooking stove that can be worked using a gas burner or using steam from an evaporator. The most dumbfounding of express fuel usage relied upon cooking using a wood pellet littler than normal warmer (0.157 kg fuel/kg tofu creation) and the least one was cook using a gas evaporator (0.047 kg fuel/kg tofu age). Soymilk cooking using a little pot could save the fuel cost and the cooking time differentiated and soymilk cooking using a gas stove, cooking using a wood pellet little warmer was the most affordable and fastest one. The most surprising of essentialness efficiency was cooking using a gas warmer (59.24%) and the least one was cook using a gas stove (33.66%)..

III. COMPONENTS OF BOILER SYSTEM

There are various backbone components of any boilers system:

1. Boiler Feed Water System

Water that converts into steam by steam boilers system called Feed water & system that regulates feed water called Feed water system. There are two types of feed water systems in boilers:
- Open feed System
- Closed feed system

There are two main sources of feed water:
- Condensed steam returned from the processes
- Raw water arranged from outside the boilers plant processes (Called: Makeup Water)

2. Boiler Steam System

Steam System is kind of main controlling system of boilers process. Steam Systems are responsible to collect & control all generated steam in the process. Steam systems send steam generated in the process to the point of use through pipes (piping system). Throughout the process, steam

pressure is controlled and regulated with the help of boilers system parts such as valves, steam pressure gauges etc.

3. Boilers Fuel System

Fuelling is the heart of boilers process & fuel system consists of all the necessary components and equipment to feed fuel to generate the required heat. The equipment required in the fuel system depends on the type of fuel used in the system.
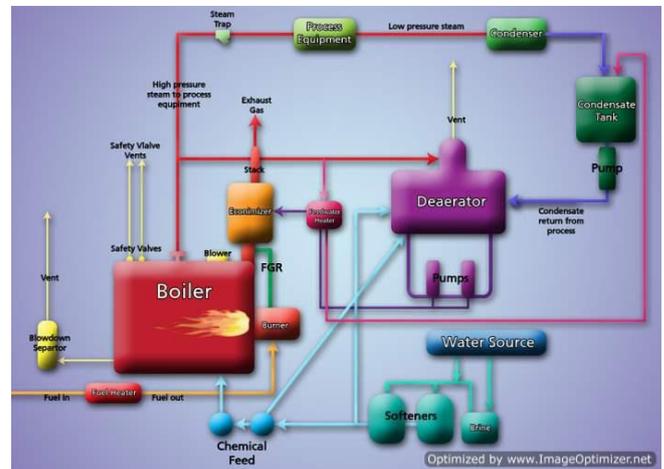

Figure 2: Schematic of Boiler System

4. Feed water Heaters

Feed water heaters are energy recovery devices generally found only in large steam generating plants where all of the steam generated is not reduced to condensate by the steam user. This "waste steam" is reduced to condensate for return to the boiler in the feed water heater. The boiler feed water is used as a cooling medium to reduce the steam to condensate, which increases the temperature of the feed water and, thereby, increases the thermal efficiency of the boiler.

5. Fuel Heater

Many boilers firing heavy fuel oil require fuel heaters to reduce the fuel viscosity, so the fuel can be atomized by the burner system for complete combustion.

6. De-Aerators

A de-aerator is a special case of feed water heater that is designed to promote the removal of non-condensable gases from the boiler feed water. The principal gases of concern are oxygen, carbon dioxide, and ammonia, which are major contributors to boilers, and steam and condensate piping corrosion problems. In small steam plants, a portion of the steam generated by the boiler is used to operate the deaerator if "waste steam" is not available. Failure to maintain and properly operate the deaerator can lead to early failure of the boiler, steam using equipment, and the steam and condensate piping.

7. Pumps

In most hot water systems, the system circulating pumps are electric motor-driven, end suction centrifugal pumps. In steam systems, the condensate return pumps are typically electric motor-driven, end suction, centrifugal or turbine-

type pumps. Feed water pumps are generally electric motor-driven, multiple-stage, end suction centrifugal pumps. The shutoff head of the pump must be greater than the steam or hot water system operating pressure.

8. Combustion Air Blowers

In many packaged boiler installations, the combustion air fan is designed and provided by the boiler manufacturer and is integral with the boiler housing. In installations where a stand-alone fan is provided, low-pressure centrifugal blowers are commonly used. An important characteristic of the blower is the ability to maintain a relatively constant air pressure over a wide range of airflows.

9. Flue

Flues (boiler firebox exhaust duct or boiler discharge stack) must be large enough to conduct the products of combustion away from the boiler with a minimum of duct friction loss. Flues may be fabricated from any material suitable for the operating temperature and pressure. Common materials of construction associated with packaged boiler installations are carbon steel and stainless steel.

10. Economizer

An economizer is an energy recovery device that uses the hot exhaust gases from the boiler (waste heat) to heat combustion air or feed water.

11. Steam Traps

Steam traps are installed throughout steam systems to remove condensate (spent steam), air, and non-condensable gases from the steam system.

IV. PROBLEM FORMULATION

Boiler is a complex system, whose combustion efficiency is of great significance for sustainable development of energy and economy. Boiler is a typically complex system which is multi-input, multi-output, nonlinear as well as non-self-balanced, and boiler combustion of power station is complex physical and chemical process. In survey, authors reported that the natural gas boiler has significantly lower CO2 emission than an equivalent coal or oil fired boiler. Therefore how to improve the combustion efficiency of natural gas boiler has always been an important issue in this field. The efficiency of a boiler system is important in several ways. The constantly rising cost of fuel used means that by increasing the efficiency by several percent, substantial savings can be made on a yearly basis. By maximizing the amount of energy extracted from the fuel, not only does the fuel usage decrease and thereby reduce cost but it also has a significant effect on the emissions from the system. Thus this work provides the performance comparison of Briquette Boiler & Furnace Boiler of Coca-Cola Plant and the ways to improve its efficiency.

The main objective of this work is to study performance analysis of Briquette & FO Boiler of Process Industry.

- Study of a Briquette Boiler & FO Operation of a Process Industry

- Performance analysis of Briquette Boiler & Furnace Oil Boiler in terms of Boiler Efficiency & cost efficiency

V. CONCLUSION

Today, in industrial facilities, process and heating applications continue to be powered by steam and hot water. The mainstay technology for generating heating or process energy is the traditional boiler. To get the most out of the boiler system it is necessary to implement a complete maintenance/efficiency plan to maintain every aspect of efficiency. The main objective of this work is to study the performance of Briquette Boiler & FO boiler in terms of their efficiency. This study will be conducted in Coca-cola Plant. The goal of this thesis has been to investigate various techniques that improve the efficiency of boiler systems. Improvements in these boiler systems takes different forms, such as reducing the operational and maintenance costs, reduce the fuel consumption or reducing the emission of polluting gases to the environment.

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