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Efficiency Performance Analysis of Briquette & FO Boiler of Beverage Industry

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Abstract: ***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. 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. The company is using a basic rankine cycle with an open system. The source of raw water for boiler is pumped from the bore wells provided by HSIIDC to the reserve pond for further internal and external treatments. These approaches are by increasing pressure, by increasing temperature and by increasing both parameters up to certain limit. The results show that the use of increase pressure and temperature can improve boiler efficiency as well as the plant efficiency as compared to other methods.***

Keywords: Briquette Boiler, Furnace Oil Boiler, Boiler Efficiency, Process Industry etc.

I. INTRODUCTION

Power is the ability to do work and work is the exchange of vitality starting with one structure then onto the next type of vitality. Vitality sources are accessible as electrical, warm, light, synthetic, mechanical, sun powered, wind, tidal, atomic vitality, etc. The coal and the rough fuel are the significant regular assets are meeting 85% of the general public need which will exhaust soon. The basic objective of vitality the executives is to deliver merchandise and give benefits the least cost and least ecological impact. The term vitality the board implies numerous things to numerous individuals. The basic definition is" The wise and powerful utilization of vitality to augment benefits (limit expenses) and upgrade focused positions".

To accomplish low carbon economy by sparing vitality is the pattern of the present society. Evaporator is a sort of basic types of gear with high vitality utilization. At present, evaporator effectiveness isn't high and a lot of vitality has been squandered intensely in China. The trial of evaporator proficiency is a viable method to recognize heater issues and improve its productivity. Until 2008, the complete number of utilizing modern boilers has been added up to 578200 units. The conventional strategy to test kettle proficiency is tedious and costly, and the trial of heater effectiveness needs extreme examination of fuel. In any case, the trial of a definitive investigation of fuel needs prolonged stretch of time, and its related gear is likewise increasingly costly. Boilers are viewed as the key part in any age station as it is where the fuel is utilized for creating the required measure of warmth. A kettle is an unpredictable incorporation of evaporator, re-warmer, super radiator, economizer, air pre radiator alongside different helpers, for example, pulverizer, fans, and so on. The reason for the presentation trial of kettle is to decide real execution and productivity of the evaporator and contrast it and configuration esteems.

Fig 1: Boiler System [1]

Boiler is a normally unpredictable framework which is non-self-adjusted, and heater ignition of intensity station is mind boggling physical and substance process. In study, it was discovered that Energy utilization at soy milk cooking was the best one in this generation. This trial study planned to examine the fuel utilization and vitality effectiveness at soymilk cooking process utilizing a smaller than normal evaporator and utilizing a gas stove. From the review, creators announced that the petroleum gas evaporator has altogether lower CO_2 emanation than an equal coal or oil terminated heater. Accordingly how to improve the burning proficiency of heater has consistently been a significant issue in this field. This exploration result demonstrated that the petroleum gas kettle had a generally high vitality maintainability list contrasted with other non-renewable energy source boilers. The significant difficulties from review are the manner by which to improve heater proficiency and furthermore vitality productivity of framework.
This paper presents classification of Boilers in section II. Section III describes the proposed system. Section IV presents the results of system. Then conclusion is presented in Section V.

II. DESCRIPTION OF BRIQUETTE & FO BOILER

The industry is the establishment of Coca-cola organization around there. It is biggest plant as far as generation and mechanization office in India in Coca-cola framework. The plant has two Boilers one is Briquette Boiler and other is FO Boiler. The Briquette Boiler has a limit of delivering 4 kg yield with 1 Kg input Briquette and FO Boiler has a limit of 10.5 kg yield with 1 Litre of Furnace Oil. For creating yield in Briquette Boiler, work cost is likewise considered on the grounds that it requires at any rate 4 people one after another. The briquette evaporator productivity will be improved by utilization of auto-feeder framework. The auto-feeder framework is in under procedure. The outcomes can be determined after culmination of establishment process.

Fig 2: Briquette Boiler in Plant

Fig 3: Furnace Oil Boiler

Table 1: Specifications of FO Boiler

Make	Shellmax FO
Standard Rating	10.54 kg/cm^2
Speed	2900 rpm
Motor Connection (starting)	DOL
Fuel Pump Type	Gear
Discharge Pressure	25 kg/cm^2
Fuel Pump Speed	1450 rpm
Voltage	415 V, 50 Hz

Table 2: Specifications of Briquette Boiler

Make	Himani Briquette
Standard Rating	10.54 kg/cm^2
Capacity	500-10000 kg/hr
Fuel Suitability	Biomass Briquette
Fuel Firing	Manual/Mechanized Feeding System
Voltage	415 V, 50 Hz

III. DESCRIPTION OF PROPOSED WORK

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.

The Plant has five manufacturing lines like PET (Carbonated Product Filling), PET-600 BPM (Carbonated and Non Carbonated Products), CAN-966 BPM (Carbonated and Non Carbonated Products), Returnable Glass Bottles (Carbonated Products) & PET Line (Packaged Drinking Water). The Manufacturing facility is capable of producing different types of carbonated & non carbonated products in different flavour & pack size as well Packaging drinking water in different size .The plant is the franchise of Coca-cola company in this area. It is largest plant in terms of production and automation facility in India in Coca-cola system. The plant has two Boilers one is Briquette Boiler and other is FO Boiler. For producing output in Briquette Boiler, labour cost is also considered because it requires at least 4 persons at a time. The briquette boiler efficiency will be improved by use of auto-feeder system.

A. Boiler Efficiency

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. Basically, boiler efficiency represents the difference between energy input and energy output. Boiler efficiency describes the fraction of fuel energy that is converted into useful steam energy. In this work, efficiency comes down to properly evaluating the performance of the boiler and the performance of the burner. There are three terms that influence boiler efficiency; Combustion Efficiency and Fuel-to-Steam Efficiency and Thermal Efficiency.

Combustion efficiency is an indication of the burner's ability to burn fuel and the ability of the boiler to absorb the heat generated. The amount of unburned fuel and excess air in the exhaust gas are used to assess a burner's combustion efficiency. Burners performing with extremely low levels of unburned fuel while operating at low excess air levels are considered efficient. In other words, combustion efficiency is measured by dividing the usable heat produced by the fuel input in MJ/h content. This calculation is based on the actual heat available produced by the system after heat loss up the stack and other heat losses which do not provide usable heat. To determine Boiler Efficiency, there are two methods that are typically utilized but generally prefer Direct Method (Input-Output Method) to calculate. It needs only the useful output (steam) and the heat input (i.e. fuel) for evaluating the efficiency. This efficiency can be evaluated using the formula:

$$Boiler\ Efficiency = \frac{Heat\ Output}{Heat\ Input} * 100$$

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B. Procedure of Finding Boiler Efficiency

1) Measure steam stream by means of kg over a set period, for example 60 minutes. Use steam integrator readings, if accessible, and right for alignment pressure. On the other hand, utilize the feed water integrator, if accessible, which will as a rule not require an amendment for pressure.
2) Measure the progression of fuel over a similar period. Utilize the gas or oil integrator, or decide the mass of strong fuel utilized.
3) Convert steam stream, feed water stream and fuel stream to indistinguishable vitality units, for example Btu/lb. or on the other hand kJ/kg.
4) Calculate the productivity utilizing the accompanying condition: Efficiency = 100 x (steam vitality – feed water vitality) ÷ fuel vitality.

C. Energy Efficiency by Frequency Reduction

In Fig 4, a Voltage Frequency Drive is introduced for examination of execution of Boiler System regarding Energy Efficiency. Without Drive, it is legitimately controlled and fixed at a solitary recurrence yet after establishment of Drive, vitality productivity is improved and furthermore lessens cost.

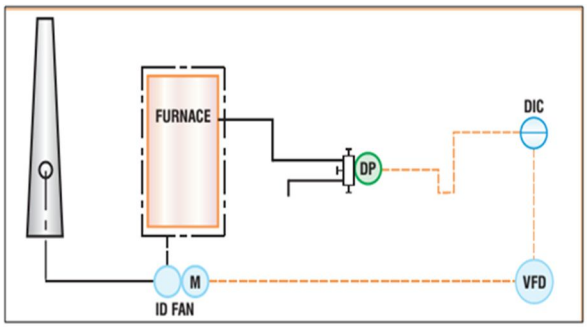

Fig 4: FO Boiler with Installation of VFD for Frequency Reduction

D. Analysis to Improve Boiler Efficiency & Plant Efficiency using MATLAB

The organization is utilizing a fundamental rankine cycle with an open framework. The wellspring of crude water for evaporator is siphoned from the close by Bore well to the save plant bore well for further inside and outside medications. Superheated steam created from heater is utilized to run steam turbine for heat age and for heat process in the plant. The fumes steam from turbine is then consolidated and later released and blended in with squander water from the plant activity to the gushing treatment. The fundamental goal of this investigation is to improve by and large heater productivity and plant proficiency. At first Steam Pressure 360 PSI and temperature 280°C separately for evaporator Operation. It is estimated soon after the evaporator at third Point in the figure. Presently, it expands the kettle strain to 5.0 MPa while superheated steam temperature is kept up at 280°C. It gives the improvement in Boiler Efficiency by modest quantity. Presently, in second case, it expands the temperature from 280°C to 400°C and weight will stay same. Just temperature will increment. At that point it additionally influences the improvement in Efficiency of System.

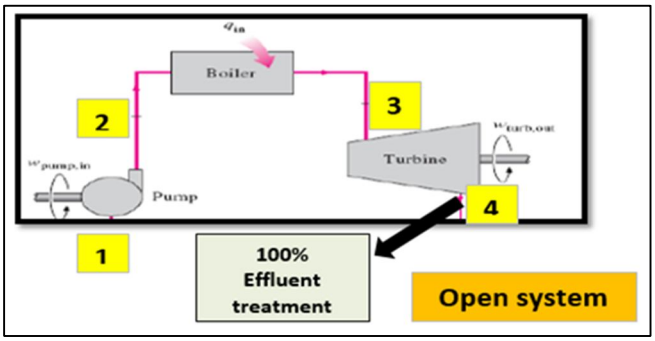

Fig 5: Analysis of System to Improve Efficiency

Presently, if at the exit of Boiler, it builds the evaporator strain to 5.0 MPa and superheated steam temperature is kept up at 400°C then both heater productivity and plant proficiency is improved as appeared in results.

IV. RESULTS & DISCUSSION

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 and performance analysis of Briquette Boiler & Furnace Oil Boiler in terms of Boiler Efficiency & cost efficiency.

In this work, it presented a comparative study of performance analysis of Briquette Boiler & Furnace Boiler used in the plant in terms of efficiency. The existing boiler is a horizontal fire-tube boiler fuelled with furnace oil. Fuel shift from present oil firing to solid fuel becomes inevitable owing to the rise in fuel cost. In view of this, the fuel system of the boiler has been changed from furnace oil to briquettes. The encompassing temperature is estimated by utilizing a Temperature Indicator. Feed water stream rate is estimated by a stream meter. Fuel utilization pace of heater oil is done by stream meter and briquette utilization is estimated by an advanced gauging machine. Feed water temperature, fuel temperature, steam temperature by Temperature Indicator, and evaporator surface temperatures are estimated by an infrared thermometer. Steam pressure is estimated by pressure check. The exhibition investigation of Briquette Boiler and FO Boiler is demonstrated as follows:

Table 3: Performance Analysis of Briquette Boiler & FO Boiler

Date	Briquette Boiler		FO Boiler	
	Briquette Consumption (Kg/ Hr)	Steam Produced (Kg/Hr)	FO Consumption (Ltr/Hr)	Steam Produced (Kg/Hr)
01-08-20	857	1149	153	1640
04-08-20	857	1142	147	1356
05-08-20	838	1142	153	1542
06-08-20	856	1150	156	1650
07-08-20	906	1125	162	1587
08-08-20	825	1156	153	1650
09-08-20	850	1150	150	1650
Average (kg Per Hr)	855		153	
Average (kg Per day)	20520		3672	

Table 4: Performance Analysis of Briquette Boiler & FO Boiler in Terms of Fuel Ratio

Date	Briquette Boiler	FO Boiler
01-08-19	1.34	10.65
04-08-20	1.33	9.17
05-08-20	1.36	10.04
06-08-20	1.34	10.56
07-08-20	1.24	9.76
08-08-20	1.40	10.78
09-08-20	1.35	11
Average	1.337	10.28
Boiler Efficiency	66.5%	73.4%

With the change of fuel arrangement of the kettle from heater oil to briquettes the organization has yielded a reserve funds of 26000 with an utilization of 1000 litre of heater oil proportional to 2100 kg of briquettes day by day.

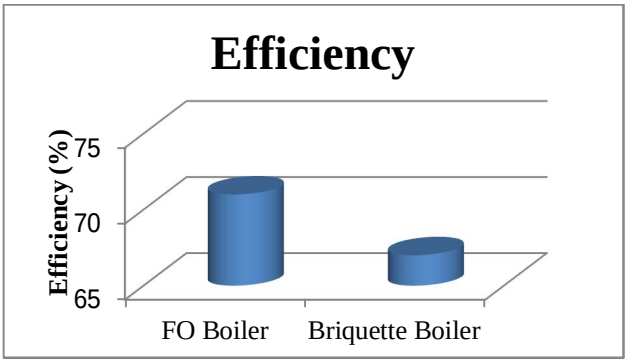

Figure 6: Performance Comparison of Boilers in Terms of Efficiency

A. Energy Efficiency by Frequency Reduction Method

Presently, results shows that however FO Boiler is effective when contrasted with Briquette Boiler yet Briquette Boiler is increasingly prudent and condition amicable. Along these lines, it needs to build its kettle productivity by reasonable methods. It tends to be finished by utilization of auto feeder framework in Briquette Boiler that decreases the sitting tight time for taking the briquettes and producing valuable yield and furthermore it very well may be finished by diminishing the recurrence of framework. Table 5 shows the exhibition of framework by vitality productivity strategy. The outcomes show that Briquette evaporator is effective as far as cost whether FO heater is better as far as proficiency execution.

Table 5: Energy Efficiency by Frequency Reduction Analysis

Details	With Out Drive	After Installation of Drive for Frequency Reduction
Motor Capacity KW	45	45
Current while Run	73	60
Unit consumed in KWH in One day	541.02636	444.6792
Unit consumed in KWH In one Month	16230.7908	13340.376
Total Consumption in one month Rs.	137961.7218	113393.196
Saving In Rs. In 1 Day	818.95	
Saving In 1 Month (Rs)	24568.52	

V. CONCLUSION

The primary target of this work is to think about the presentation of Briquette Boiler and FO kettle as far as their effectiveness. This investigation is directed in beverage industry. The objective of this proposal has been to examine different methods that improve the effectiveness of evaporator frameworks. One of their plant is right now working with low effectiveness and execution of its heater and turbine, as contrast with the appraised limit. Right now, the organization is utilizing an essential rankine cycle with an open framework. The wellspring of crude water for evaporator is siphoned from the drag wells gave by HSIIDC SAHA to the hold lake for further inner and outside medicines. For examination and improvement, three methodologies are utilized and investigated by MATLAB Tool. These methodologies are by expanding pressure, by expanding temperature and by expanding the two parameters up as far as possible. The outcomes show that the utilization of increment weight and temperature can improve heater proficiency just as the plant productivity when contrasted with different techniques.

In Future, it can be investigated using auto feeder setup for improving briquette Boiler efficiency and also for reducing cost.

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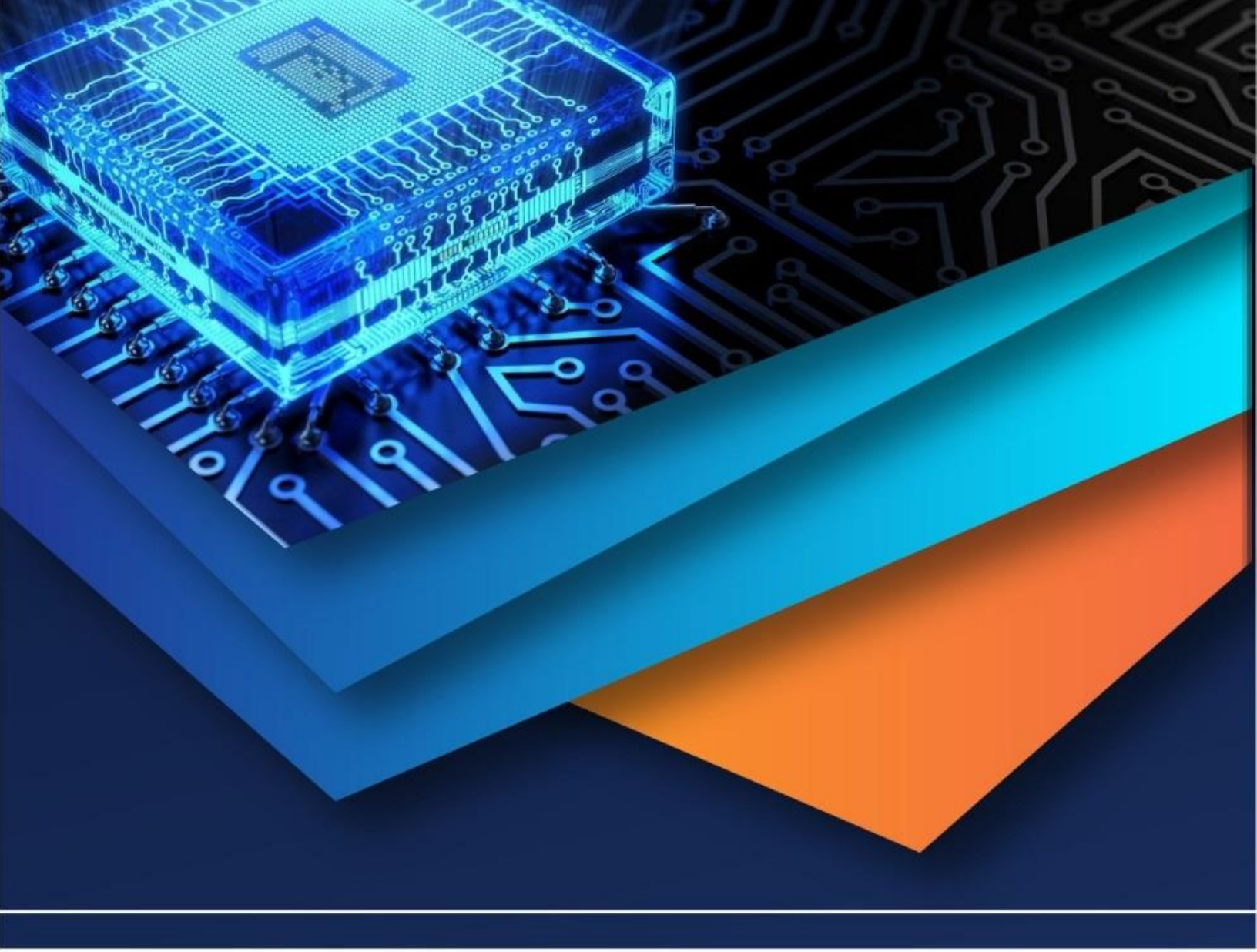

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