International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VI **Month of publication:** June 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 5 Issue VI, June 2017
ISSN: 2321-9653

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Analysis of Boiler Efficiency

Pratik Oswal[1], Fahad Vanjara[2], Anand Devkar[3]
Final Year Students, Mechanical Engineering, SMT Kashibai Navale College of Engineering, Maharashtra, India

Abstract: A boiler (heat producer) is like the heart of a car, this provides the necessary heat that the facility needs to warm itself up. There are two types of boilers: Fire-tube and water-tube. In fire-tube boilers, combustion gases pass through the inside of the tubes while water surrounds the tubes. In a water-tube boiler, the water pass through the inside of the tubes and combustion gases surrounds the tubes. Data of boiler thermal efficiency can replicate the boiler operation condition, heat creation and loss. Performance of the boiler, like efficiency reduces over time, due to underprivileged combustion, heat transfer fouling and underprivileged operation and maintenance. Boiler efficiency can also be useful in examination of boiler and can also be used in analytical maintenance of the boiler. How to reduce problems of the boiler efficiency computation and be thriving in calculating the boiler thermal efficiency on line is the main distress of operation departments of power systems. The efficiency is calculated by direct method and the boiler under study if fire-tube boiler. Fuel used is briquettes.
KeyWords: Boiler, Direct method, Efficiency, Heat lost, Financial loss

I. INTRODUCTION

A boiler (heat generator) is like the heart of a car, this provides the heat that the facility needs to warm itself up. The size of the boiler is coordinated to the size of the facility. If the boiler is outsized, the fuel bills will be extreme. If the boiler is small, it may not generate an adequate amount of heat. The prominence is majorly on energy conservation, and the fact that heat loss calculations can be done very precisely, means there is no need to oversize.

A. Fire Tube Boilers

Combustion gases pass through the inside of the tubes while water surrounds outside the tubes. The most common fire-tube boilers used in facility heating applications are often referred to as scotch or scotch marine boilers, as this boiler type was commonly used for marine service because of its compact size

The advantages of a fire-tube boiler are its simple construction and less rigid water treatment requirements.

The disadvantage is the extreme weight-per-pound of steam generated.

B. Water Tube Boilers

The water pass through the inside of the tubes and combustion gases surround the tubes on the outside. The industrialized water-tube boiler usually produces steam mostly for industrial process applications, and is used less repeatedly for heating applications

The advantage of a water-tube boiler is a low unit weight-per-pound of steam produced.

The disadvantages are high initial cost & cleaning is more difficult due to design.

II. EFFICIENCY CALCULATION

The efficiency depends on numerous parameters leaving combustion and thermal efficiencies. These other parameters comprise of convection losses, blow down losses, radiation losses etc. There are two methods used to determine out boiler efficiency, namely direct method and indirect method of efficiency calculation.

A. Direct efficiency

This method calculates boiler efficiency by using the basic efficiency formula-

η=(Energy output)/(Energy input) X 100

In order to calculate boiler efficiency by this method, we divide the total energy output of a boiler by total energy input given to the boiler, multiplied by hundred.

Calculation of direct efficiency-

E= [Q (H-h)/q*GCV]*100

Where,

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Q= Quantity of steam generated (kg/hr)
H= Enthalpy of steam (Kcal/kg)
h= Enthalpy of water (kcal/kg)
GCV= Gross calorific value of the fuel.(Briquettes)

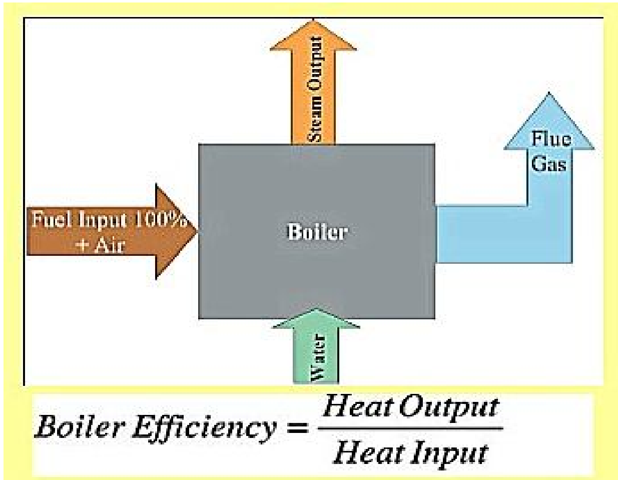


Fig -1: Direct Method

Dated : 3/6/17
E= [Q (H-h)/q*GCV]*100
Q=1000 kg/hr
=0.27778 kg/sec
H=2768 kJ/kg
h=721 kJ/kg
H-h=2047 kJ/kg
=489.03435 kcal/kg
q=4620.8 kg/day
=0.053481 kg/sec
GCV=3800-4000 kcal/kg
=3900 kcal/kg (average)

$$E = \frac{0.27778*489.03435}{0.053481*3900}$$

E =65.12% E(Obtained)=58% E(Manf quoted)=75%
LOSS=7-10%

Table -1: Efficiency Table

Date	Q(kg/sec)	q(kg/sec)	H-h(kcal/kg)	η
1/6/17	0.27778	0.04572	489.03435	76.1
2/6/17	0.27778	0.05851	489.03435	59.52
3/6/17	0.27778	0.05348	489.03435	65.12
4/6/17	0.27778	0.06335	489.03435	54.97
5/6/17	0.27778	0.06343	489.03435	54.9

Average efficiency = 61.37%
GCV = 3900 kcal/kg (constant)

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

B. Heat Loss Calculation

Dates:3/6/17

While Shoveling The Briquettes:

Convection heat loss:

Q= q/t = hA(Ts-Ta)

=15 x (2 x 0.56 x 0.42)(235-31.5)

=1435.896 watts

Heat loss= Q x t

=1435.896 x 135 x 60

= 11630757.6 joules/day

Radiation heat loss:

$Q= e\sigma A(T^4 - T^4_a)$

$= 0.97 \times 5.6703 \times 10^{-8} \times 0.4704 (508^4 - 304.5^4)$

=1500.6276 watts

Heat loss= Q x t

=1500.6276 x 135 x60

=12155083.56 joules/day

Total heat loss= 23785841.16 joules/day

= 23785.84116 kJ/day

C. Financial Loss Calculation

(A,B, are variables)

We spend 8.5 INR per unit of electricity.

1 unit = 1 kWh

1 kWh = 1000 x 3600 Ws

$= 3.6 \times 10^6$ J

8.5 INR $\longrightarrow$ 3.6×10^6 J

Money lost through shoveling:

8.5 INR $\longrightarrow$ 3.6×10^3 kJ

A INR $\longrightarrow$ 23785.84116 kJ

A= 56.16 INR

Money lost due to extra work:

Average cost to produce 1 kg of steam is 1.58 INR

Efficiency of boiler is 65.129%

To produce 1000kg of steam, boiler will have to do work for 1000+34.871% of 1000

i.e :

1000+348.71

Excess work done by boiler is 348.71

Now,

1.58 INR $\longrightarrow$ 1 kg

B INR $\longrightarrow$ 348.71 kg

B = 550.9618 INR (per hour)

= 13223.08 INR (per day)

Total financial loss = A+B

=56.16+13223.08

= 13279.24 INR (per day)

= 48,46,922.6 INR (yearly)

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Table -2: Financial Table

Date	Extra work(kg)	Loss per hour(INR)	Loss per day(INR)	Total Financial loss(INR)(A+B)
1/6/17	239.8	377.620	9062.88	9119.04
2/6/17	404.8	639.584	15350.10	15406.26
3/6/17	348.71	550.960	13223.08	13279.24
4/6/17	450.8	712.264	17094.33	17150.49
5/6/17	481.0	759.980	18239.52	18295.68

Average cost per day = 14650.14 INR

Average cost per year= 53,47,301.38 INR

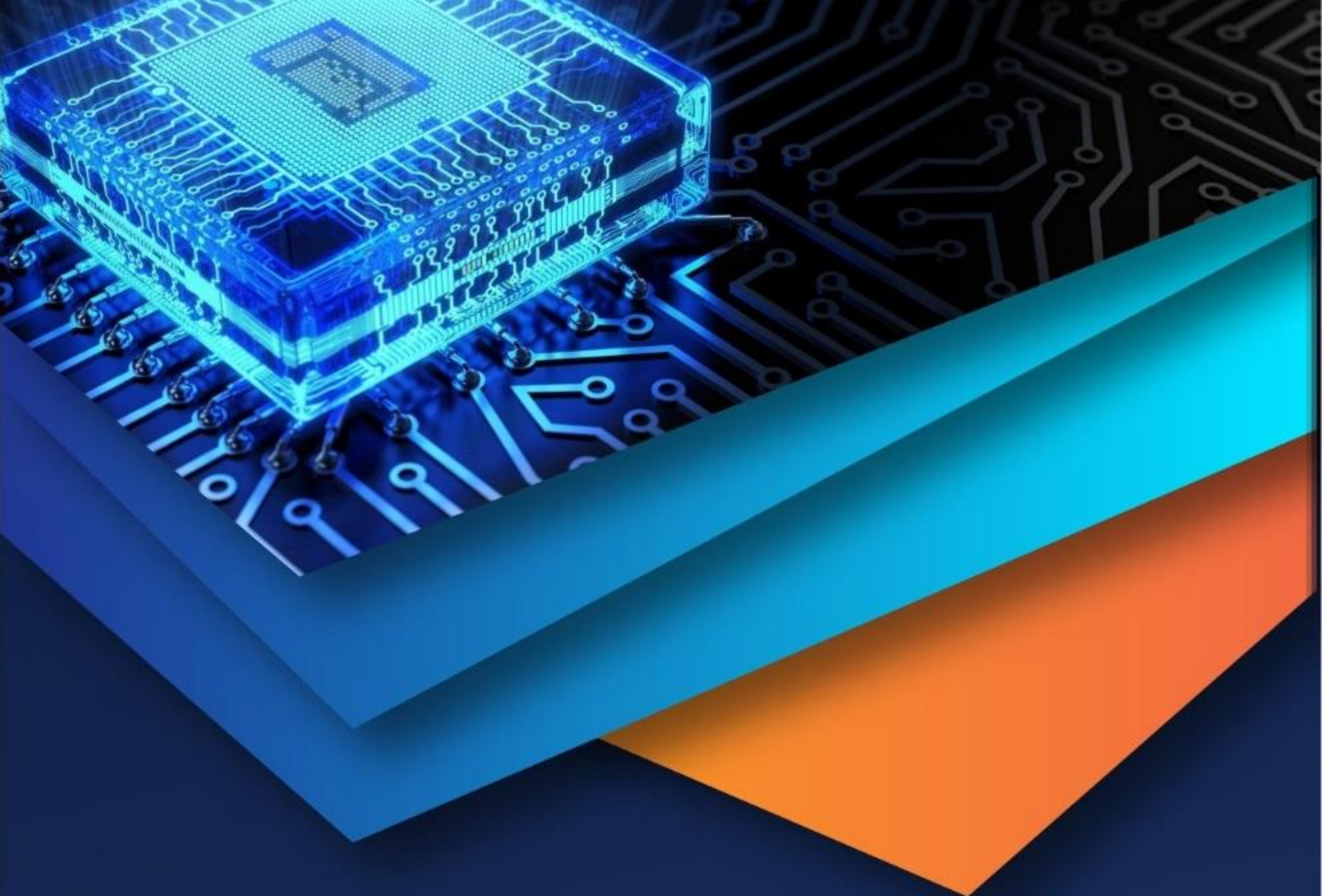
III. CONCLUSIONS

This paper is convergent on the diverse aspect of the operation of Boiler. Efficient operation of boiler is likely to play a very huge role in years to come. Industries all over the world are going through increased and powerful competition and increased automation of plants. The cost of such system is expected to be very high. To get cross with this challenge, it is clearer by this paper about the financial losses of the system . We have to use advanced technology and management skills in all spheres of activities to perform its effective role in the turnover of the company.

REFERENCES

[1] Mechgreen: about fuel and energy usage(https://mechgreen.wordpress.com/2011/08/08/21/)

[2] Image source :https://www.google.co.in/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=0ahUKEwiggreg2snUAhUFGJQKHez0BvwQjRwIBw&url=https%3A%2F%2Fwww.slideshare.net%2Futsavjain19%2Fenergy-performance-assessment-of-boilers&psig=AFQjCNHaPP0oaDHLRkhoNj26gaqpU01ZvA&ust=1497952206397165



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY