iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** X **Month of publication:** October 2021

DOI: https://doi.org/10.22214/ijraset.2021.38605

Performance of Oil Fired Steam Boiler (100 Kg / Hr)

Sandip D Patil[1], Rahul M Pawar[2], Ganesh R Sharma[3]
[1]PG Scholar, Rajarambapu College of Sugar Technology And Project Co coordinator Datacone Engineers Sangli Maharashtra
[2]HOD Sugar Technology Department, Rajarambapu College of Sugar Technology Islampur Dist Sangli Maharashtra
[3] Project Engineer Datacone Engineers Sangli Maharashtra

***Abstract:** Steam boiler or simply a* boiler *is basically a closed vessel into which water is heated until the water is converted into steam at required pressure. To study the performance, Graphs are to be plotted for Pressure , Temperature , Boiler Efficiency, Equivalent Evaporation.*

***Keywords:** Dryness Fraction, Pressure, Boiler Efficiency, Equivalent Evaporation , Separating And Throttling, Condenser Efficiency.*

I. INTRODUCTION

The basic working principle of boiler is very simple and easy to understand. The boiler is essentially a closed vessel inside which water is stored. Fuel is bunt and hot gasses are produced. These hot gasses come in contact with water vessel where the heat of these hot gases transfer to the water and consequently steam is produced in the boiler . Boiler efficiency depends upon the size of boiler used . Actually there are some losses occur like incomplete combustion, radiating loss occurs from steam boiler surrounding wall, defective combustion gas etc. In water tube boiler the water is heated inside tubes and hot gasses surround these tubes. In sugar industries mostly water tube boiler is used.

To study the performance, Graphs are to be plotted for Pressure variation , Temperature variation , Boiler Efficiency , Equivalent Evaporation

Fig. 1 Boiler setup with condenser and Separating And Throttling Calorimeter

II. EXPERIMENTAL SETUP

The experimental setup consist of oil fired Non IBR Boiler of 100 Kg/Hr Capacity with economizer.To measure the dryness fraction of steam separating throttling calorimeter is provided . Shell and tube type condenser with reciprocating type vaccum pump.The whole setup is mounted on a self-contained sturdy iron Frame

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue X Oct 2021- Available at www.ijraset.com

III. FORMULAS USED

1) *Boiler Efficiency* = (Heat Exported by Outlet Steam / Heat Supplied by Fuel) x 100
   = $M_a(h_s-h_w) / M_f \times C_V$
   Where M_a is the mass of steam in Kg/hr = 100kg/hr
   hs is the final enthalpy of steam in KJ/kg (from the steam table corresponding to steam pressure (Absolute Pressure) in bar and dryness fraction, (X=0.8) , = $h_f + x\ h_{fg}$
   h_w is the initial enthalpy of steam in KJ/kg from the steam table corresponding to water inlet temperature to boiler
   Mf is the mass of fuel in kg/hr = 5.25 kg/hr
   C. V. is the calorific value of uel (Diesel) = 45980 KJ/kg.

2) *Equivalent Evaporation* = $M_a (h_s - h_w) / 2257$ Kj / Hr
3) *Dryness Fraction* = (X_1) x (X_2) , Where
   X_1 = Dryness fraction of steam by separating method = $M_T / (M_T + M_S)$
   (M_T = Mass of water collected inn separating calorimeter , M_S = Mass of water collected in throttling calorimeter)
   X_2 = Dryness fraction of steam by throttling method = $(h_{g2} + C_p (T_2 -) - h_{f1}) / h_{fg1}$
   Where,
   h_{g2} = Total Heat of Steam at Pressure P_2 in KJ/Kg.
   C_p = Specific Heat Of Steam after Throttling(T_2) in KJ/Kg = 2.01 KJ/Kg
   T_2 = Temperature of Steam Inside Throttling Calorimeter
   T_{s2} = Saturated Temperature of Steam at Pressure P_2 in ^OC
   h_{f1} = Enthalpy of water at Pressure P_1 in KJ/Kg.
   h_{fg1} = Enthalpy of Evaporation at Pressure P_1 in KJ/Kg.

4) *Condenser Efficiency* = Actual cooling water temperature rise / Max. Possible temperature rise
   = $(t_{w2} - t_{w1}) / (t_s - t_{w1})$

Where t_{w1} is the circulating cooling water inlet temperature
t_{w2} is the circulating cooling water outlet temperature
t_s is saturation temperature corresponding to Condenser pressure 0.2 bar = 60.09^0C
(From steam table)

TABLE I
Boiler Details

Sr No	Technical Specification	
1	Steam Output	100 kg/Hr
2	Working Pressure	10 kg/cm^2
3	Fuel Consumption (Diesel)	5.25 kg/hr
4	Blower and Fuel Motor	0.5 HP
5	Feed Water Pump	0.5 HP
6	Design	Three Pass

TABLE II
Boiler Observation Table

	Water Inlet temperature to economizer	Water outlet temperature from economizer	Steam Temperature	Steam Pressure (Gauge) Kg/cm^2	Exhaust Gas Outlet Temperature
1	28	36	123	1.5	194
2	28	42	138	2.5	204
3	28	50	157	5	212
4	28	55	166	6	218
5	28	56	170	7	220

TABLE III
Experimental Calculated values for Boiler Efficiency and equivalent Evaporation wrt observation Table

Sr No	Boiler Efficiency %	Equivalent Evaporation Kg/ Kg of Fuel
1	88	17.84
2	83.14	16.96
3	78.79	16.02
4	76.92	15.64
5	75.83	15.44

TABLE IV
Observations for Separating and Throttling Calorimeter

Sr No	Separating Calorimeter Temperature T_1	Separating Calorimeter Pressure kg / cm^2 P_1	Mass of water collected in separating calorimeter	Throttling Calorimeter Temperature T_2	Throttling Calorimeter Pressure kg / cm^2 P_2	Mass of water collected in Throttling calorimeter	Dryness Fraction (X) Calculated
1	130	1.8	30	101	0.4	0.4	0.74
2	140	2.9	30	105	0.5	0.5	0.75
3	146	3.5	35	107	0.6	0.6	0.79
4	157	4.4	35	110	0.7	0.7	0.81

TABLE V
Condenser Details

Sr No	Technical Specification	
1	Shell Diameter	300 mm
2	Shell And Tube Length	1000 mm
3	Tube Diameter	20mm
4	No of Tubes	18
5	Water Inlet Pipe Diameter to Condenser	32 mm
6	Orifice Diameter in water supply Pipe	22 mm
7	Pressure Difference across orifice	0.2 Kg/cm^2

TABLE VI
Condenser Observation Table

	Steam Inlet temperature to condenser	Condensate outlet temperature from condenser	water inlet Temperature to condenser	water Outlet Temperature from condenser	Condenser Pressure Bar with reciprocating vacuum pump	Water Flow Rate to Condeser LPM	Condenser efficiency Calculated %
1	95	54	25	29	0.2	90	11.42
2	97	56	25	30	0.2	90	14.28

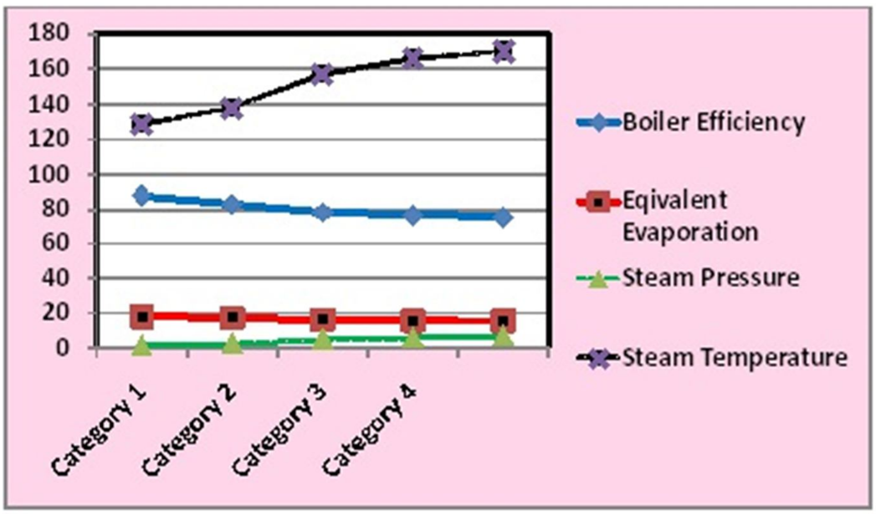


Fig. 2 Boiler Efficiency , Equivalent Evaporation, Steam Pressure , Steam Temperature Graph

IV. CONCLUSION

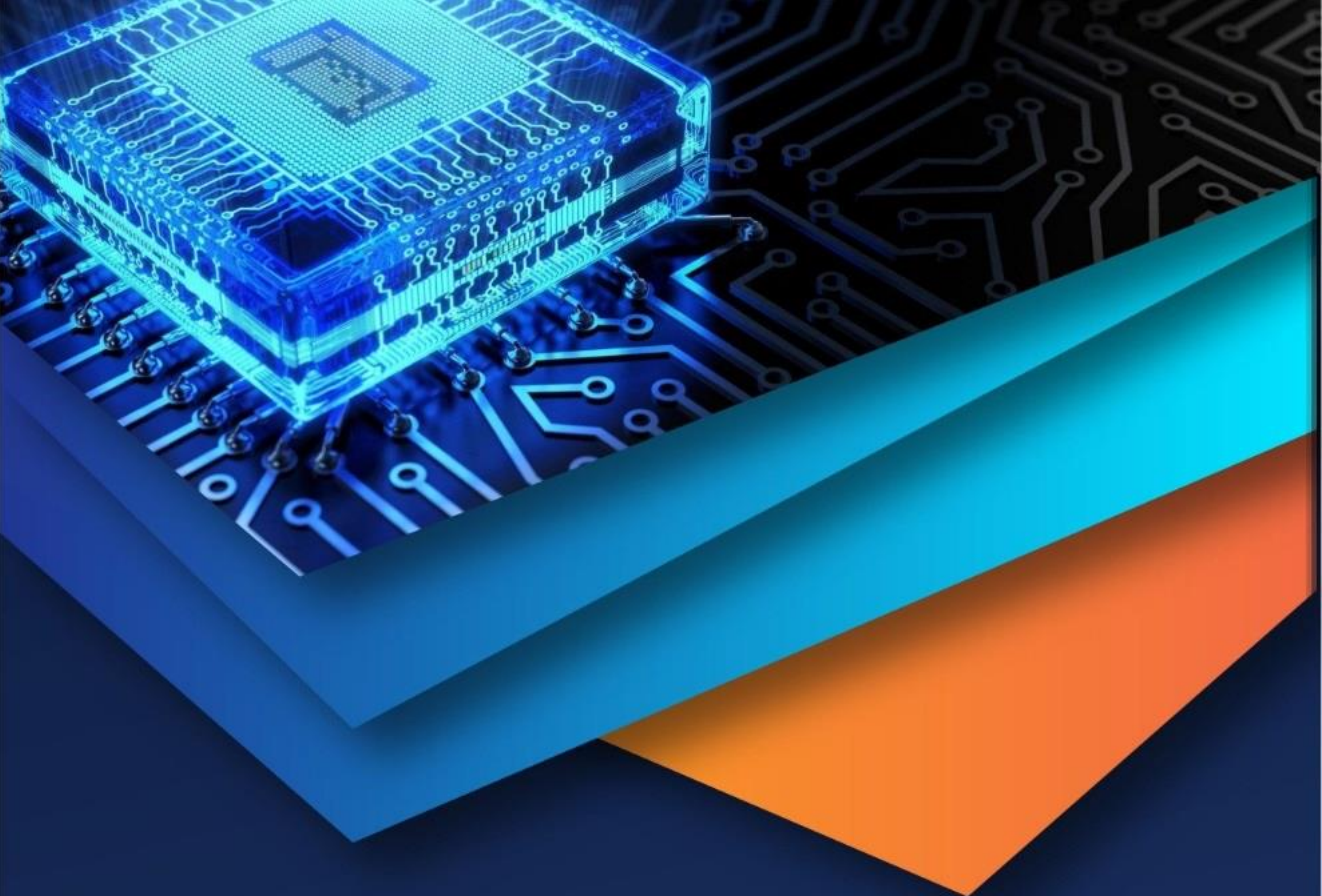
From the Graph of Boiler Efficiency and Equivalent Evaporation , It is observed that Equivalent evaporation increases with increase in boiler efficiency.
From the Graph of Pressure Vs Temperature , It is observed that as pressure increases corresponding temperature also increases.

REFERENCES

[1] Warren L McCabe , Julian C. Smith, Peter Harriot. (1993) Unit Operations Of Chemical Engineering.Fifth Edition. New York: McGraw-Hill
[2] J.M.Smith , H.C.VanNess, M.M.Abbott. (1996) Introduction to Chemical Engineering Thermodynamics.Fifth Edition. New York: McGraw-Hill
[3] E Rathakrishan. (1993) Gas Tables. University Press (India)Limited Hydrabad
[4] Steam and gas turbines and power plant engineering, by Dr. R. Yadav.
[5] Power plant engineering , by GK Pathak

AUTHOR

Sandip D Patil, PG Scholar Rajarambapu College of Sugar Technology And Project Co coordinator Datacone Engineers Sangli Maharashtra – sandipdpatil456@gmail.com.
Rahul M Pawar , HOD Sugar Technology Department Rajarambapu College of Sugar Technology Islampur Dist Sangli Maharashtra – rahul.pawarsugartech@gmail.com
Ganesh R Sharma Project Engineer Datacone Engineers Sangli Maharashtra-sharma.ganesh77095@gmail.com



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY