Analysis And Design Of 3- Fluid Heat Exchanger For Utilization Of Waste Heat In The Boiler

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ABSTRACT

Our project relates to recover the waste of flue gases heat in boiler and utilize it in pre-heat the boiler feed water and air before they apply to the economizer & air-preheater. The heat which is going to waste from the exhaust is recover by using the piping system connect to exhaust and from there it is connect to Boiler feed water storage where it increase the temperature Of water, then supply to economizer, so it works effectively. And after way another pipe is connected from exhaust air supply, where it increase temp of air, than this air is supply to combustion chamber and combustion faces place very easily. The project Aims at making 3- fluid heat exchanger. It has following features.

1. Efficiency

The efficiency of boiler is increase up to 20% by recover the Waste heat and utilize it in pre –heat feed water and Air.

2. Waste heat utilization

The heat which is going waste from exhaust is utilize by piping system connected form exhaust to feed water storage and air-supply

Keyword: - *flue gas waste heat, economizer, air-preheater, combining, 3- fluid heat exchanger*

1. INTRODUCTION

1.1 Problem statement

AS per the data we came to know through industry, the main problem associated with is the new concept of 3 fluid heat exchangers is not working. Atmospheric air temperature is about 20C to 25C and water temperature is same as

air. Inlet necessary temperature of air and water is require 75C But, because of wrong pitch length & surface area, require temp is not get. we replace the existing design and made new design in PV elite software.:

1. Improper Design

Because of improper design the waste heat is not going from exhaust to economizer & air-preheater.

2. The heat is not recover.

The amount of heat recovery is very less and other heat is going waste.

1.2 Aim and Objectives of the project

Out aim is to improve the current design of existing model ,which comprise of the all above list problems and eliminate the same by given solution our main aim is to this new design of model to Gujrat metal Industry. We personally believe that this equipment is going to benefit them to a great extent.

1.3 Problem Specification

The problems as specified above are obstructing the application of boiler in industry, otherwise, this new concept Of 3-fluid heat exchanger has a greater scope to work.For the soln of problems we change the piping system of the existing design and made redesign of model.For the maximum amount of heat recovery from join the piping system from exhaust to economizer & air-preheater. As the heat is freely move.

2. DESIGN & MECHANISM

This 3D model had been made in PVLITE 2016 by actual dimension and selected mechanism also.

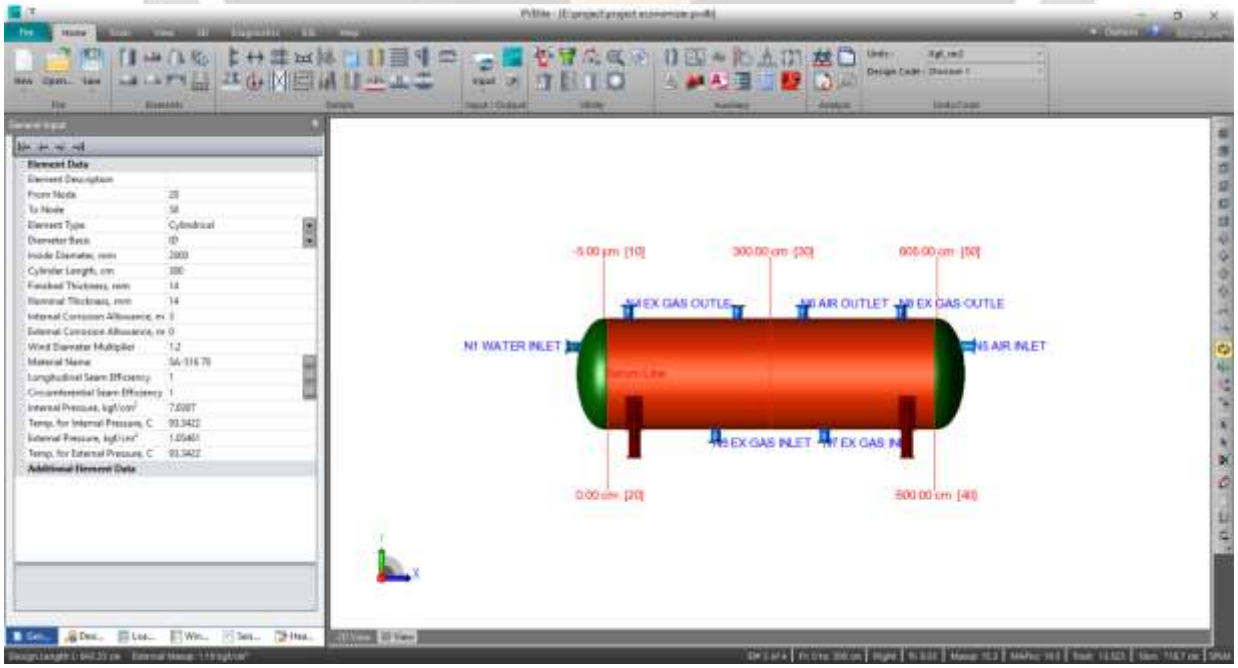

Fig -1 : 3D Model

2.1 MATRERIAL AND DETIAL

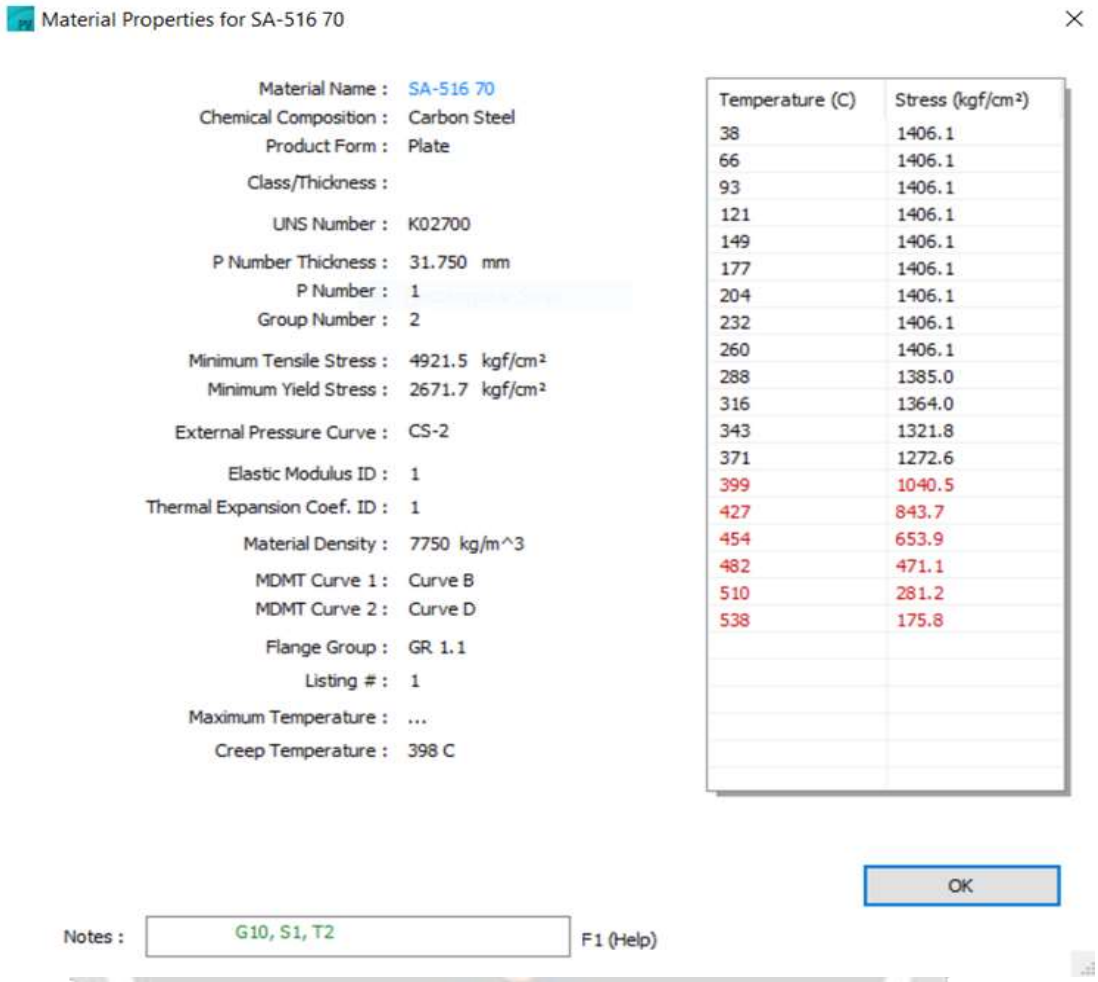

Fig (2) material properties for SA-516 70

3 Why combination of Economizer and Air Pre-Heaters are Provided for Heat Recovery

Boilers are provided with economizer and air pre-heaters to recover heat from the flue gases. An increase of about 20% in boiler efficiency is achieved by providing both economizer and air pre-heaters. Providing economizer alone gives only 8% efficiency increase and so designers provide both.

Most of the high capacity boilers firing coal operate with an efficiency of around 86% on the Higher Heat Value basis. Loss of around 14% can be attributed to various losses of which the dry gas loss is about 35% of the total. When both economizers and air pre-heaters are not provided the boiler efficiency drops to around 66% from 86%.

When air pre-heater is not provided the boiler efficiency will be around 74 % only. Thus we can conserve about 20% extra fuel when we provide both economizers and air pre-heaters in boiler

4 CALCULATION

INPUT VALUES, Nozzle Description: N1 WATER INLET From : 10

Pressure for Reinforcement Calculations	P	7.031 kgf/cm²
Temperature for Internal Pressure	Temp	93 °C
Design External Pressure	Pext	1.05 kgf/cm²
Temperature for External Pressure	Tempex	93 °C
Shell Material		SA-516 70
Shell Allowable Stress at Temperature	Sv	1406.14 kgf/cm²
Shell Allowable Stress At Ambient	Sva	1406.14 kgf/cm²
Inside Diameter of Elliptical Head	D	2000.00 mm
Aspect Ratio of Elliptical Head	Ar	2.00
Head Finished (Minimum) Thickness	t	14.0000 mm
Head Internal Corrosion Allowance	c	3.0000 mm
Head External Corrosion Allowance	co	0.0000 mm
Distance from Head Centerline	L1	500.0000 mm
User Entered Minimum Design Metal Temperature		-20.00 °C

Type of Element Connected to the Shell *: Nozzle*

Material		SA-106 B
Material UNS Number		K03006
Material Specification/Type		Smls. pipe
Allowable Stress at Temperature	Sn	1202.25 kgf/cm²
Allowable Stress At Ambient	Sna	1202.25 kgf/cm²
Diameter Basis (for tr calc only)		ID
Layout Angle		90.00 deg
Diameter		6.0000 in.
Size and Thickness Basis		Nominal
Nominal Thickness	tn	80

Flange Material		SA-105
Flange Type		Weld Neck Flange
Corrosion Allowance	can	3.0000 mm
Joint Efficiency of Shell Seam at Nozzle	E1	1.00
Joint Efficiency of Nozzle Neck	En	1.00
Outside Projection	ho	164.6000 mm
Weld leg size between Nozzle and Pad/Shell	Wo	10.0000 mm
Groove weld depth between Nozzle and Vessel	Wgnv	10.0000 mm
Inside Projection	h	0.0000 mm
Weld leg size, Inside Element to Shell	Wi	0.0000 mm
Pad Material		SA-516 70
Pad Allowable Stress at Temperature	Sp	1406.14 kgf/cm²
Pad Allowable Stress At Ambient	Spa	1406.14 kgf/cm²
Diameter of Pad along vessel surface	Dp	340.0000 mm
Thickness of Pad	te	8.0000 mm
Weld leg size between Pad and Shell	Wp	6.0000 mm
Groove weld depth between Pad and Nozzle	Wgpn	8.0000 mm
Reinforcing Pad Width		85.8625 mm
ASME Code Weld Type per UW-16		None
Class of attached Flange		150
Grade of attached Flange		GR 1.1

Reinforcement CALCULATION, Description: N1 WATER INLET

ASME Code, Section VIII, Div. 1, 2015, UG-37 to UG-45

Actual Inside Diameter Used in Calculation		5.761 in.
Actual Thickness Used in Calculation		0.432 in.

Reqd thk per UG-37(a)of Elliptical Head, Tr [Int. Press]

= (P*K1*D))/(2*Sv*E-0.2*P) per UG-37(a)(3)

= (7.03*0.897*2006.0000)/(2 *1406.14*1.00-0.2*7.03)

= 4.5029 mm

Reqd thk per UG-37(a)of Nozzle Wall, Trn [Int. Press]

= (P*R)/(Sn*E-0.6*P) per UG-27 (c)(1)

= (7.03*76.16)/(1202*1.00-0.6*7.03)

= 0.4470 mm

Required Nozzle thickness under External Pressure per UG-28 : 0.5347 mm

UG-40, Limits of Reinforcement : [Internal Pressure]

Parall el to Vessel Wall (Diameter Limit) Dl 317.2953 mm

Parallel to Vessel Wall, opening length d 158.6477 mm

Normal to Vessel Wall (Thickness Limit), pad side Tlwp 27.5000 mm

Note : The Pad diameter is greater than the Diameter Limit, the excess will not be considered .

Weld Strength Reduction Factor [fr1]:

= min(1, Sn/Sv)

= min(1, 1202.2/1406.1)

= 0.855

Weld Strength Reduction Factor [fr2]:

= min(1, Sn/Sv)

= min(1, 1202.2/1406.1)

= 0.85

Weld Strength Reduction Factor [fr4]:

= min(1, Sp/Sv)

= min(1, 1406.1/1406.1)

= 1.000

Weld Strength Reduction Factor [fr3]:

= min(fr2, fr4)

= min(0.855 , 1.000)

= 0.855

5 ADVANTAGES

1.reducing the fuel costs by means of additional heating energy through efficient heat recovery

2. increasing the degree of efficiency up to 11%

3. suitable for all waste heat boiler / flue gas boiler / boiler types

4. suitable for all standard fuels

5. Maximize efficiency and save money

6. Increase steam boiler efficiency and decrease heat loss.

7. Save the fuel needed to perform combustion process

8. The size of furnace can be smaller because the requirement heat surface is less than witho using economizer.

9. Higher feed water temperature tend to reduce boiler thermal stersses, so life boiler increased

10. Preheated air increases combustionrate and than increases steam generations rate of biler.

11. due to higher temperature of air, furnace temperature increases ,so low grade coal can be burnt efficiently.

1. CONCLUSIONS

Due to this new design so many conclusion taken which is as follows. By the combination of air pre-heater and economizer in 3 fluid heat exchanger by the efficiency of boiler is increase up to 20% and the losses of flue gases is reduce up to certain level by using it into again in 3 fluid heat exchanger.

6.REFERENCES

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