Experimental & Investigation of Tool Design for Reheater

J. Mohamed Thaslim[1] K. Aravindhan[2] A. Nedumaran[3] C. R. Saraboji Sankar[4]
[1,2,3,4]UG Scholar
[1,2,3,4]Department of Mechanical Engineering
[1,2,3,4]Parisutham Institute of Technology & Science, Thanjavur. Tamilnadu, India

Abstract— Reheater is a set of pipe coils located in the boiler it starts from high pressure steam to the low pressure and from there to the inter mediate and low pressure turbines. High reheating temperature improve the output and efficiency of a power- plant. They are the same as the super-heaters buy as their exit temperature are a little bit less than super heater and their pressure is 20%-25% less than the super heater they can stand less quality material alloys. The construction of re heater coil bend is consider out by using nipple bended the machine can bend a tube only up to a length 10m. The TIG welding process carried out. Which cost is high and simultaneously cycle time increases. Rectify the difficulties and new die is create a design for R142. Which can be placed over system bender machine by doing so the length of the tube can be increased up to 20m and the STB welding can also be implemented? It cost less than the TIG welding cycle time also reduces and the terminal former mounting in the system bender. Here, the principle of reheater is a rankine cycle. The heat can be converted into heat into mechanical work and the heat can be supplied to the closed loop. This cycle the temp and pressure are in critical stages and the cycle of the temperature can be increased to the critical point.

Key words: Reheater; Rankine Cycle; STB Joint; Temperature (^{0}c) ; Velocity (m/s)

I. INTRODUCTION

The boiler is a major part used in a all the power plant and they produced large amount of heat can be generated to produce the power. The power plant consist of more number of components there are

- Super heater
- Reheater
- Turbine
- Economizer
- Generator

The major reheating component is reheater. The coil can reheat the steam and increase it temperature.

Fig. 1: Reheater

In boiler the major use of the component is reheater. Reheater is a component used to reheat the steam and increase the temperature in the circuit of reheater.

The reheater can consist of 12 circuits of coil they are heat treated in the furnace and the coil can be heated the steam enter into it in generally the coil can be make for 10m and they coil can be cut and make a TIG welding and cost of the welding is high. We investigate the problem identified in this process to rectify by the new method. In this process we implemented the STB (straight tube butt) joining can be implemented to rectify the older method to increase the coil production up to 20m and also reduced the cost of the welding process. By using the STB joint we make a 50 joint per hour and its cost is very less compare to TIG welding. In TIG welding process they used more number of electrodes to join the tube but in STB joint the usage of electrode coil is reduced. In this process the bend can be produced by the system bender machine by replacing the nipple bender machine. After the production of coil they undergoes some testing called fluoroscopy hydro test and air testing method to find the defects occur in the tube. The steam can be obtained from the turbine it enter into the reheater and again it can be heated and increased the temperature at the same pressure and velocity. The coil can be designed in solid works and ANSYS 14.5 to analyze the flow of liquid in the reheater coil.

Fig. 2: System Bender Machine

Fig. 3: Former Die

II. COMPUTATIONAL WORK

A. 3D Model & 2D Model

3d model of reheater can be designed by using a SOLID WORKS and then they contain a 12 circuit and the interior coil can be designed in 3d model.

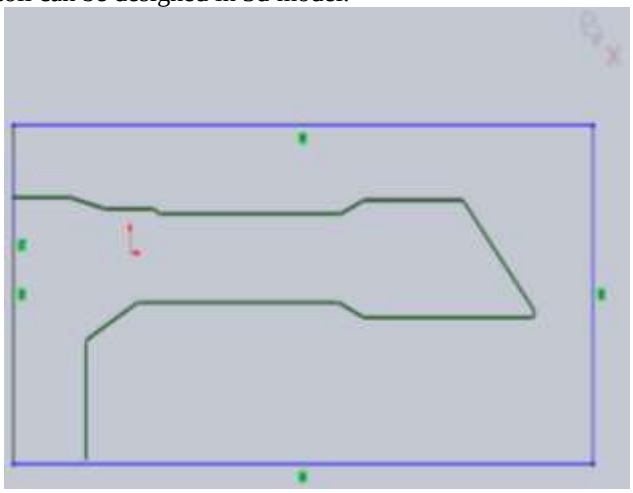


Fig. 4: Reheater

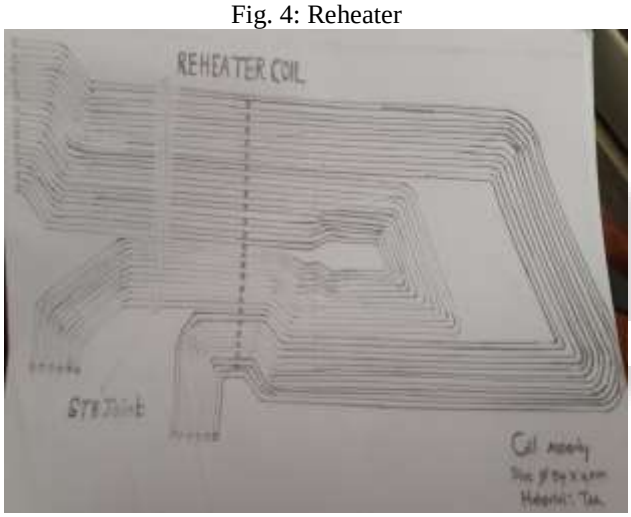


Fig. 5: STB Joint Reheater

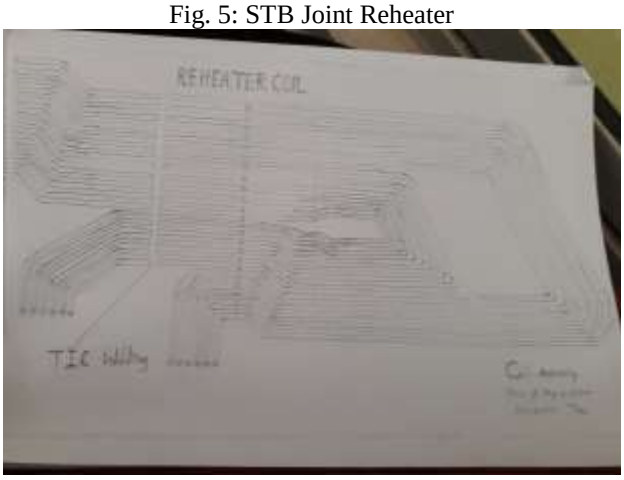
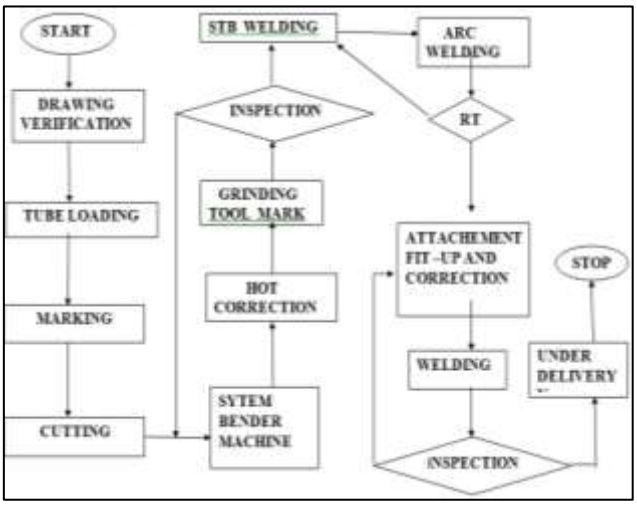


Fig. 6: TIG welding Reheater

B. Methodology



C. Our Implementation

1) Old Method

A coil is a set of tubular product which has been used in boiler. The coil consist of 12 circuits. The circuit outer diameter is greater than inner diameter. In thermal power plant there exist of 51 coils. The reheater coil can be cutting for offset bending for move to the nipple bender. The offset part can be joined by using the TIG welding manually to form a coil. The construction of coil is consider by using a nipple bender the machine can bend a tube up to 10m.

2) New Method

A new method has to be identified to replace the bending operation from system bender machine. We implementing the new method to rectify the difficulties facing in the already existing process. We decided to design a terminal former die to used in system bender machine to bend the tubes. In system bender machine where there is rotary movement. To make a bend at 120°and the tool can be changed the design. In previous method they using the TIG welding process to construct a coil up to 10m but we implemented the STB WELDING to increase the length up to 20m in the system bender. The cost of the process can be less compare to previous existing method. In this process we used the tool design with the radius of R142 to make the coil.

The present offset is of two types,

- Two bends with equal depth and pitch
- Two bends with different depth

D. Material Specification

MATERIAL GRADE	SPECIFICATION
Low Carbon & Steel Seamless	ASTM A179, DIN 17175 ST 35.8, SA 192
Low carbon steel welded	ASTM A 214, ST 37.8
Low Alloy Steel - Seamless	ASTM A 199 / A213, T1,T11,T12,T22,T5,T9,DIN 17175- 15 Mo3.16 Mo5, 16Cr Mo44, 1010 Mo910, 12 CrMo195, X12Cr Mo91.
Stainless Steel	304, 304 L,321,316,316L,316 T,317,347,347,HF4,310 S

Seamless / Welded	446,405,410,S31803,UNS 83904,S 31500, X S Cr N,189
Non Ferrous	ASTM B111,Grade 142,122,272,260,443,687,706,715

E. Difference between TW

Activity	Before Implementation Bending In Rotary Machine	After Implementation Bending In System Bender
Coil formation with straight panel	3 shifts/ 3manpower= 9 fitter shifts	No need to form straight coil
Preparation of the joint	1 shifts/ 2 manpower =2 fitter shifts	No need for joint
Hot correction of bend	10 bends / shifts -3 manpower – total - 22 shifts	No need for hot correction
Grinding of the tool marks	2 manpower -2 fitter shifts	No need for grinding
TIG welding	4 joints per shift – 3 manpower (2 fitter and 1welder) – 36 welder shifts and 72 fitter shifts	No need for TIG welding
Defect repair (15%)	5 welder shifts , 10 fitter shifts	No need
Coil formation with bend tubes	Not done	3 shifts / 3 manpower = 9 fitter shifts
Total cycle time	132 fitter shifts, 41 welder shifts	itter shifts only

F. Cost Estimation

Cost of TIG welding:
Total numbers of joints in a coil: 144
Numbers of filler rods required for one joints: 5 electrodes
Cost of the filler rods: Rs.5.25 (T12 filler rod material code: 545812400000)
Total number of filler rods for one coil: 5*144=720
Cost for filler rods =Rs.3, 780
Cost for radiography: Rs. 70/ joints – Rs. 11,550 per panel for (144+21(defect rate) joints)
Cost for hot correction: cost of acetylene cylinder and oxygen: Rs.1, 414 and Rs.270

III. Result

There is a limit to the degree of super-heat due to the metallurgical conditions, therefore it is not possible to get all super-heat in one stage. The inevitable effect of use of higher pressure in power plants is that, the saturation line is reached which is highly undesirable. In this method the cost of the reheater can be reduced and also the energy can be produced up to 540mw in the power plant can be produced in the presence of reheater coil.

IV. Conclusion

It has been identified that there are many difficulties over the current existing process to rectify this difficulties we suggested to replace the bending machine from CNC Nipple Bender Machine to system Bender by designing a new die in System Bender machine, by doing so the length of the tube can be extended up to 20m.

The cycle time reduces comparing to previous method parallel inspection do not require Radiographic testing too as the TIG joints are eliminated and STB is suggested.

This brings the profit of about Rs.1,02,57,606 per year.

The products bend profit obtained by implementing the new die is being inspected by Quality Council (QC) and it is approved for further process.

References

[1] M.M. Prieto, I. Suárez, F.J. Fernández, H. Sánchez, M. Mateos, "Theoretica development of a thermal model for the reheater of a power plant boiler" February 2007
[2] P.A. González-Gómez, F. Petrakopoulou,'J.V. Briongos, D. Santana' "Cost-based design optimization of the heat exchangers in a parabolic trough power plant" 6 June 2016, Revised 31 January 2017
[3] Hong xu, bo deng, dongfang jiang, yongzhong ni, naiqiang zhang' "The finite volume method for evaluating the temperature of the reheater tubes in power plant" 5 February 2017

