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ANALYSIS OF SHALL AND TUBE HEAT EXCHANGER TO ENHANCE THE PERFORMANCE OF BOILER

Ashutosh Kumar[*1] & Yash Kumar[2]
[*1]Lecturer "Xavier Institute of polytechnic &Technology" ,Namkum,Ranchi
[2]PG Research scholar "Technocrat Institute of Technology" ,Bhopal

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ABSTRACT
This paper present an approach for the optimization of shall and tube heat exchanger for inline tube arrangement. Poor performance for shall and tube heat exchanger is a reason for higher unit heat rate & deterioration for boiler efficiency due to losses of flue gas temperature as a sensible heat loss. Here different value of velocity is used to find out the flow characteristics on CFD. & it shows that fluid velocity affects the overall heat transfer coefficient

KEYWORDS: Shall And Tube Heat Exchanger , CFD, Creo Parametric, Mass Flow Rate .Flue Gas Temperature.

I. INTRODUCTION

Shall And Tube Heat Exchanger
Shell and tube heat exchanger are the classification of recuperative heat exchanger consist of bundle of tubes enclosed with in cylindrical shell one fluid pass through the tubes and second fluid flows between the tube and shells. The basic components of a shell and tube heat exchangers are tubes, tube sheets, shell and shell-side nozzle, channel covers, pass divider, baffles etc. most commonly used STHE have large heat transfer surface area-to-volume ratios to provide high heat transfer efficiency in comparison with others. They are mechanically enough to withstand the fabrication stresses and normal operating conditions. This can be easily cleaned and the failure parts like gaskets and tubes can be easily replaced. They can offer greater flexibility of mechanical features to withstand at any service requirement. This is manufactured easily in a large variety of sizes.

Types Of Heat Exchanger
Basically There Are Two Types Of Heat Exchanger.

Direct contact heat exchanger –
In that both media between which heat is exchanged are in direct contact with each other.
Indirect contact heat exchanger –

In that both media are separated by a wall through which heat is transferred so that they never mixed.
Shell and tube heat exchanger is the indirect contact type of heat exchanger; here the series of tubes are used in which one of the fluid runs. The tube side and shell side fluids are separated by tube sheet. Thin baffles are used for diverting the flow, support the tube for rigidity and obtained higher heat transfercoefficient. Helical baffles give the better performance than the single segmental baffles, but their manufacturing, maintenance and installation cost is high

II. LITERATURE REVIEW
A literature has been reviewed on the shell & tube heat exchanger. It has been study that the research in this field mainly took place in the following area:
- Working
- Design of shell & tube heat exchanger
- CFD on material

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Digvendra singh et al;[5]. designed and Performed the Evaluation of a Shell and Tube Heat Exchanger using Ansys After modifying the heat exchanger the effectiveness of heat exchanger is increased by changing the shell side fluid (from water to methanol). Methanol provide sufficientcooling to as compared water in heat exchanger and increase the effectiveness of heat exchanger up to 95.5%.

Harshwardhan Uddhage et al;[7] have performed the numerical simulation for heat exchanger with different number of baffles, baffle cut, tube diameter and tube length are performed The baffles changes the direction of flow which leads to turbulence of fluid flow which causes increase in heat transfer characteristics but also leads to increase in pressure drop. The flow profile of main fluid stream depends upon the number of baffles, their arrangement, height of baffle cut and tube length.the diameter of tube influences the heat transfer characteristics the heat exchanger with 10 baffles and 36% baffle cut shows the best performance.

Shiva Kumar et al;[11], presented the numerical simulation of finned double pipe heat exchanger with hot fluid flowing in the inner tube and cold fluid in the annulus. After validating the results for a bare heat exchanger with the experimental results Simulation was done using rectangular, triangular and concave parabolic finned configurations on the outer body of inner tube. Results indicate that finned configurations show an overall improvementthe thermal characteristics compared with unfinned one. For better performance of heat exchanger, flow rate of the cold fluid should be kept low where as that of the hot liquid should be Rectangular finned configuration constant value of 0.02kg/s, as much was increased, the effectiveness of the fins increased and rectangular fins showed highest effectiveness and is 21% and 11.5% higher than parabolic and triangular based fins.Parabolic fins showed minimum pressure drop for all mass flow rates. It has reduced by 38% and 65% compared to the triangular and rectangular finned tube. In addition to this even they provide the advantage of lesser material and hence reduced weight. Hence it can be concluded that parabolic finned configuration can be a better alternative compared to the triangular and rectangular because of reduced pressure drop and reduced weight of the finned assembly even though the thermal performance is being marginally reduced.

Swapnaneel Sharma et al;[16] have performed the comparative study between the conventional type square fined tubes & triangular finned tubes & investigate that pressure drop in the finned tube is high thereby making requirement of large pumping power, By using shorter length tube high pressure requirement is minimize. Pressure drop in the shell is very low, further, effectiveness of the square finned tube HX is quite similar with triangular finned tube HX

Bayram Sahin et al;[17] The parameters affecting the heat transfer are Reynolds number, fin height and fin spacing (pitch). Heat transfer can be successfully improved by controlling these parameters. The maximum heat transfer rate was observed at 42,000 Reynolds number, 75 mm fin height and 3.417 Sy/D.

III. CFD ANALYSIS

The analysis is taken on CFD platform to study the flow behavior of flue gases and air on STHx at different boundary cobdition initial the velocity taken for both shall side and tube side is 0.8 m/s and gradually increases to 1.3 m/s to find the overall heat transfer coefficient between shall and tube heat exchanger

Table 3.3.Parameter of STHx

1.	Shell outer Diameter	323mm
2.	Shell Thickness	6 mm.
3.	Length of the shell	500 mm
4.	Tube outer Diameter	12.5 mm
5.	Tube Thickness	1.65 mm
6.	Tube type	Finned tube
7.	Transverse Pitch	37.5 mm
8.	Longitudinal pitch	37.5 mm
9.	Type of Tube layout	Square layout
10.	Type of Tube Arrangement	In line Arrangement
11.	No of tube inside the shell	36
12	Fin thickness	2 mm.
13.	Fin height	6 mm
14.	Type of Fin	Triangular fin

Table 3.2–Boundary condition for flue gas

Sr.No.	Parameters	Unit	Value
1.	Pressure at outlet	Gauge	0
2.	Velocity at inlet	m/s	0.85
3.	Wall		No slip & escape
4.	Default interior		Fluid(flue gas)

Table 3.2–Boundary condition for aie

Sr.No.	Parameters	Unit	Value
1.	Pressure at outlet	Gauge	0
2.	Velocity at inlet	m/s	6
3.	Wall		No slip & escape
4.	Default interior		Fluid(air)

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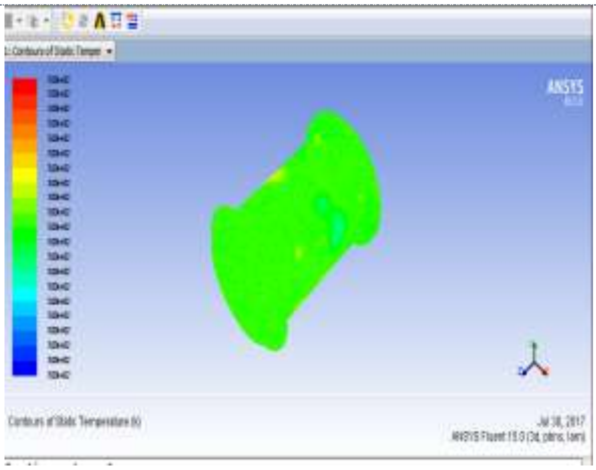

Fig 3.1 Shall Side Contour Of Static temperature

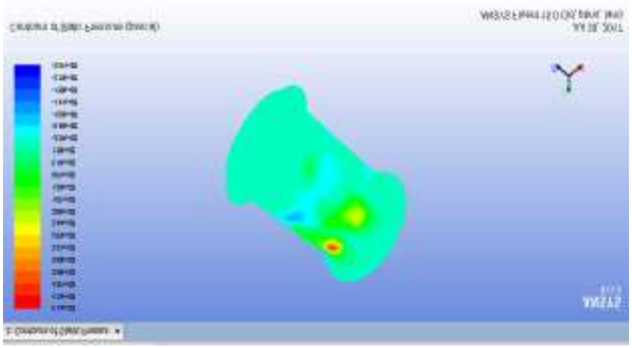

Fig 3.2 Shall Side Contour Of Static Pressurre

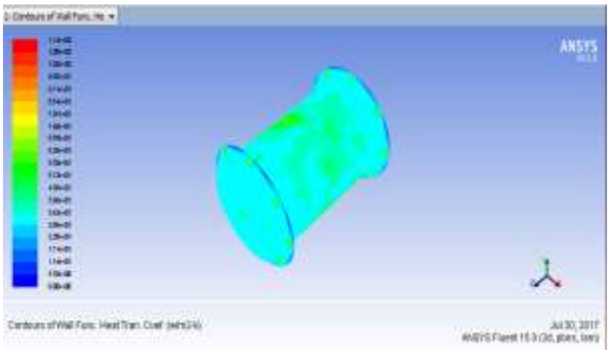

Fig 3.3 Shall Side Contours Of Surface Heat Transfer Coefficient

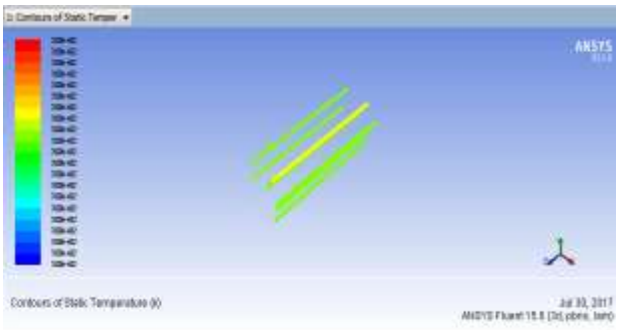

Fig 3.4 Tube Side Contours Of Static TemperaturFig

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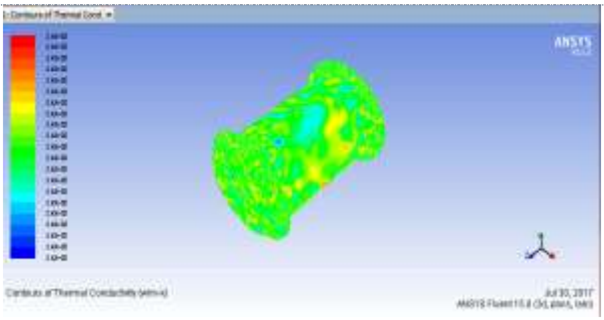

Fig 3.5 Shall Side Contours Of Thermal Conductivity

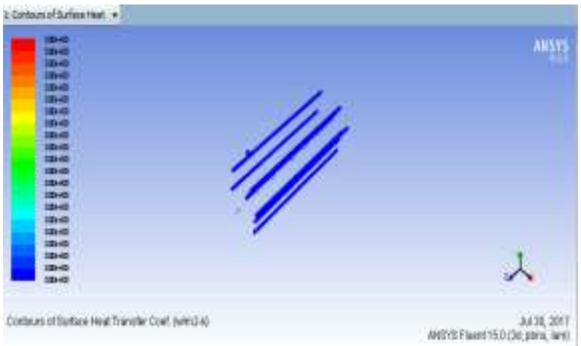

Fig 3.6 Tube Side Contours Of Surface Heat Transfer Coeff.

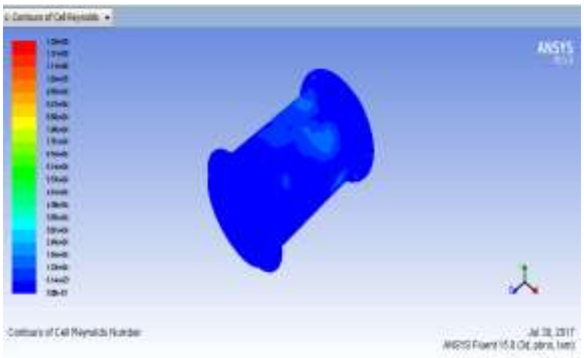

Fig 3.7 Shall Side Contours Of Cell Reynolds Number

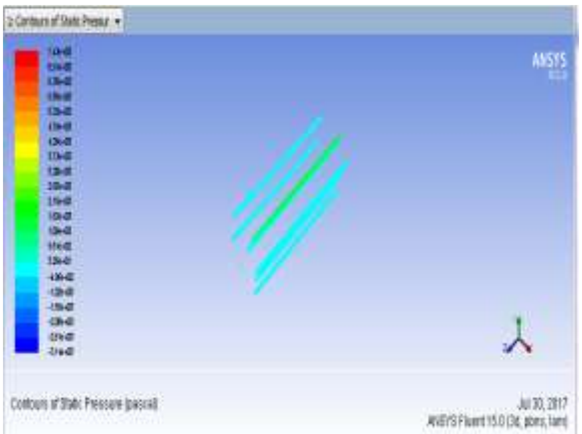

Fig 3.8 Tube Side Contours Of Static Press

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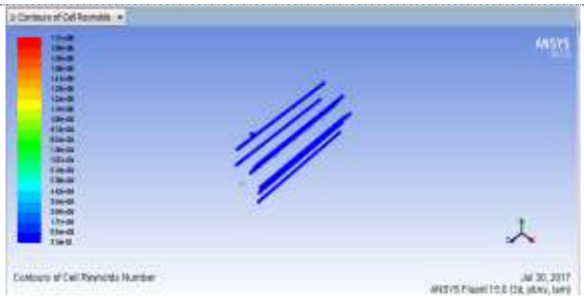

Fig 3.9 Tube Side Contours Of reynolds number

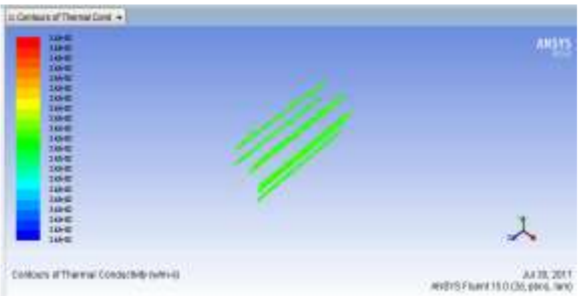

Fig 3.10 Tube Side Contours Of thermal conductivity

IV. CONCLUSION

Experiment have been performed with the shell & tube heat exchanger of unit-3 Monnet Ispat & Energy Limited, Raigarh (C.G.) with varying outlet temperature i.e. initially were 156^{O}C. Data taken from 3 shift log book with 24 hours on average basis. On 125^{O}C. outlet temperature keeping other parameter constant.it recover 1^{0}C of sensible heat loss.It conclude that.on reduction of 31ºC of STHx outlet temperature or flue gas outlet temperature,boiler efficiency improved by 1% and upon increasing the fluid velocity by 0.15 m/s overall heat transfer coefficient increased by 23.00W/m^{2}K.

Several attempt being made to reduce flue gas outlet temperature,gas flow rate become objective to control outlet flue gas flow temperature.by decreasing flow rate by 2000kg/hr flue gas outlet temperature reduces by 3.74ºC.which ultimately reduce sensible heat loss& thereby increasing boiler efficiency.

Experiment have been performed for the geometry obtain from the site . One can optimize the design of tube to enhance the performance of boiler.

This study will help in understanding the performance of shall & tube heat exchanger under different operating condition (viz static pressure, dynamic pressure, velocity duct,velocity pipe

V. REFERENCES

[1] Alparslan Demir, Bayram Sahin, permormance analysis of heat exchanger having perforated square fins. Applied thermal engg 28(2008) pp-621-632.
[2] Amol S. Niphade, Design, CFD Analysis of Shell & Tube Heat Exchanger with CFD Analysis for Dairy Application,India ,International Journal of Advance Foundation And Research In Science & Engineering (IJAFRSE)Volume 2, Issue 9 Impact Factor: 1.036, Science Central Value: 26.54(March 2016)pp-673-677
[3] Dawit Bogale, Design and Development of Shell and Tube Heat Exchanger for Harar Brewery Company Pasteurizer Application (Mechanical and Thermal Design) American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-03, Issue-10, pp-99-109
[4] Digvendra singh, Narayan Das Pal, Designing and Performance Evaluation of a Shell and Tube Heat Exchanger using Ansys(Computational Fluid Dynamics) International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-2, Issue-3,ISSN: (March 2016) pp-2395-3470
[5] Durgesh Bhatt, Priyanka M Javhar,Shell and Tube Heat Exchanger PerformanceAnalysis, International Journal of Science and Research (IJSR)ISSN (Online): 2319-7064,pp-1872-1879

[6] Ebieto, C.E and Eke G.B. Performance Analysis of Shell and Tube Heat Exchangers:A case study, Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 3(5):pp-899-903
[7] Harshwardhan Uddhage, Sanjay Kumbhare, Krishna Kumar Thakur. Design And Development Of Shell And Tube Heat Exchanger By Using CFD,International Journal of Scientific and Research Publications, Volume 5, Issue 12, 676 ISSN (December 2015) pp- 2250-3153
[8] Hetal Kotwal,D.S PATEL, CFD Analysis of Shell and Tube Heat Exchanger- A Review International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 2, (March 2013)pp-325-329
[9] M.Thirumarimurugan, 2T.Kannadasan and 3E.Ramasamy, Performance Analysis of Shell and Tube Heat Exchanger Using Miscible System, American Journal of Applied Sciences 5 (5): (2008),,pp-548-552
[10] P.N Sapkal & P.R Baviskar,To Minimize The Air Preheater Design For Better Performance (2011)pp-62-69
[11] Shiva Kumar, K. Vasudev Karanth, Krishna Murthy, Numerical study of heat transfer in a finned double pipe heat exchanger, ISSN 1 746-7233, England, UK,World Journal of Modelling and Simulation,) No. 1, Vol. 11 (2015)pp. 43-54
[12] Shravan H. Gawande, Sunil D. Wankhede1, Rahul N. Yerrawar1, Vaishali J. Sonawane1, Umesh B. Ubarhande, Design and Development of Shell & Tube Heat Exchanger for Beverage, http://dx.doi.org/10.4236/mme.2012.24015 Published Online November 2012 (http://www.SciRP.org/journal/mme) Modern Mechanical Engineering, (2012) pp-121-125
[13] Ender Ozden, Ilker Tari Shell side CFD analysis of a small shell-and-tube heat exchanger Department of Mechanical Engineering, Middle East Technical University, 06531 Ankara, Turkey, Energy Conversion and Management 51 (2010) 1004–1014
[14] Vindhya Vasiny Prasad Dubey),_(Raj Rajat Verma),_(PiyushShankeVerma),_(A.K.Srivastava), Design and Development of Shell & Tube Heat Exchanger for Beverage, Published Online November2012 (http://www.SciRP.org/journal/mme) Modern Mechanical Engineering, (2012) pp-121-125
[15] Priyanka M Javhar, Shell and Tube Heat Exchanger PerformanceAnalysis, International Journal of Science and Research (IJSR)ISSN (Online): pp-2319-7064I
[16] Swapnaneel Sarma, D.H.Das, CFD Analysis of Shell and Tube Heat Exchanger using triangular fins for waste heat recovery processes, IRACST – Engineering Science and Technology: An International Journal (ESTIJ), ISSN,Vol.2, No.6, (December 2012:) pp-2250-3498
[17] Bayram Sahin, Alparslan Demir, Thermal performance analysis and optimum design parameters of heat exchanger having perforated pin fins., Energy Conversion and Management 49 (2008) pp-1684–1695
[18] R.Pachaiyappan, J. Dasa Prakash,Improving The Boiler Efficiency By Optimizating The Combustion Air(August 2015)pp-238-242
[19] Vishal H Acharya, A Review on Investigation of Shell and Tube Heat Exchanger For Different Parameter, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 02 (Feb -2017),pp-875-878

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