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Design and Analysis of Water Tube Boiler Drum with Radiator Attachment

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Abstract **- In the present scenario energy crisis is a severe problem across the world. For the protection of environment and to maintain natural balance, energy saving is one of the most essential issue from the view point of fuel expenditure. Therefore, it is essential that we should concentrate on producing more heat by using same amount of fuel by making significant and concrete efforts. In this paper main objective of the researcher is to study and analyze the feasibility of system so that it can help to produce more heat energy for steam generation. An attempt has been made for easy approach of more heat energy, which is being generated by a furnace system by using Radiator technique. The heat is used to produce steam for boiler Feed. The demand & supply and storage requirement is attempted. Such an organization can be made-up in the work shop of a plant and preliminary testing can be carried out. This study will be center of attention on the fact that such a system is technically feasible and economically viable.**

Keywords - Heat, Boiler Efficiency, Radiator Technique

I. INTRODUCTION

Boiler is a mechanical system which converts the chemical energy of the coal in to the thermal energy in the form of steam. It acts as a heat exchanger which exchanges the heat between flue gases that are generated by the combustion of fuel and feed water which later on is converted in to steam.

In the boiler there are certain inputs and output as shown in the figure 1.1

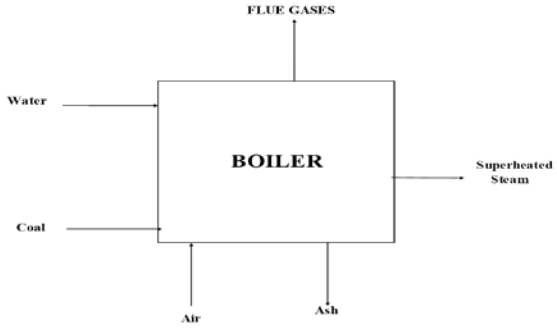

Fig.1.1 - Basic boiler working diagram

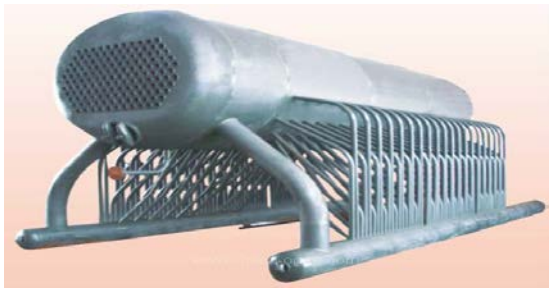

Fig.1.2 - Old model of boiler drum

II. 3D MODEL BOILER DRUM & ITS ANALYSIS

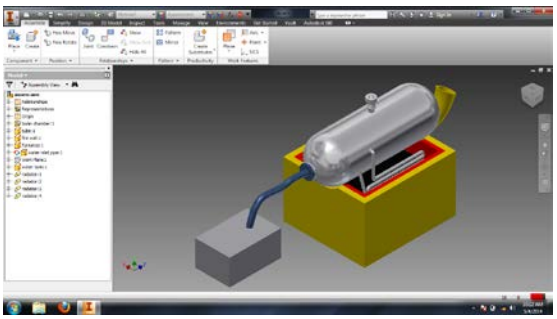

Fig. 2.1 - New model of boiler drum with radiator attachment

An illustrated model of new boiler has been shown in figure 2.1. It has greater water capacity, heating surface which the furnace being entirely enclosed

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with water surface than the old boiler. The high-water level is about 50 square inches (1562500 mm^2), and at low-water level 60 square inches (22500 mm^2). The vertical section is 18-inch barrel(450 mm), 50 inches long(1250 mm) overall and 48 inches(1200 mm) long between the end plates, and 20 inches(500mm) in diameter. The furnace flue is 2-1/2 inches(62.5 mm) across outside, and contains eleven 1/2-inch cross tubes(12.5 mm), place as indicated by the end view, and 3/4 inch apart(18.75mm), centre to centre. This arrangement gives a total heating surface of about 140 square inches (12250000 mm^2). If has fairly smaller tubes and doubled, or even tripled, the heating surface may be increased to 180-200 square inches (20250000 mm^2 – 25000000 mm^2).

Flat Panel Radiators

This type of radiator has integrated grilled and end panels. Flat Panel Radiators tend to be used in commercial state of affairs. They are rather attractive and are perfect for a room intended to have the minimalistic look and feel. It is shown in figure 2.2.

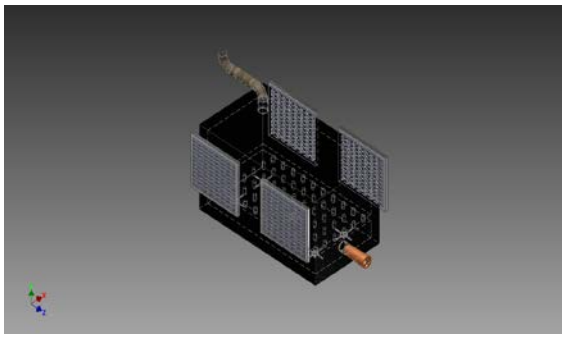

Fig. 2.2 - ***Flat Panel Radiators***

In new boiler drum, radiator coils are parallely attached with boiler drum, as shown in figure 2.3.

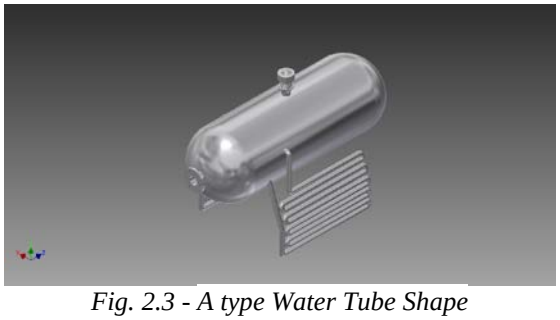

Fig. 2.3 - A type Water Tube Shape

In new boiler drum, radiator coils and steam nozzle are attached with boiler drum, as shown in figure 2.4.

Fig. 2.4 - Arrangement of New Boiler

In figure 2.5 CFD analysis in radiators coil by using Altair's software.

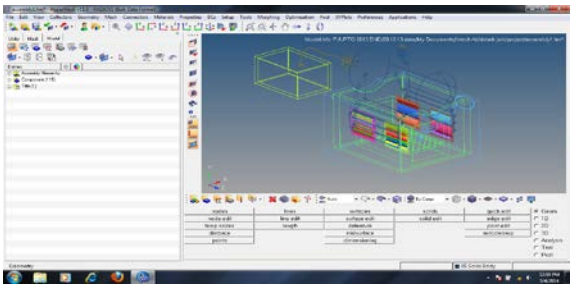

Fig. 2.5 - CFD analysis in Radiators coils

CFD analysis in radiators coil by using Altair's software is shown in figure 2.6. Red zone is indicating maximum velocity 6.88 $e^{-3}$of fluid and light blue zone indicates minimum fluid velocity is -1.71 e^{-01}.

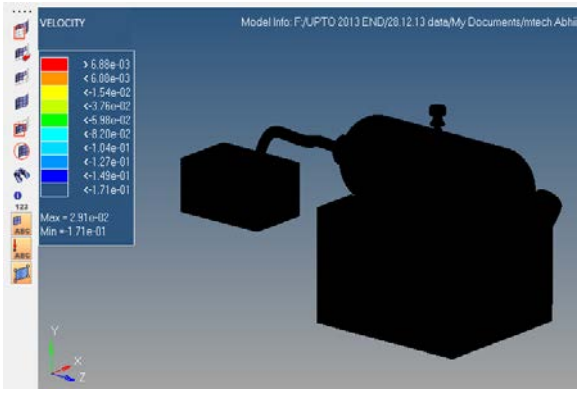

Fig. 2.6 - Velocity analysis in boiler drum

CFD pressure analysis in radiators coil by using Altair's software has been shown in figure 2.7. Red zone is indicating maximum velocity 1.93 $e^{-01}$of fluid and light blue zone is indicating minimum fluid velocity is 1.92 e^{10}.

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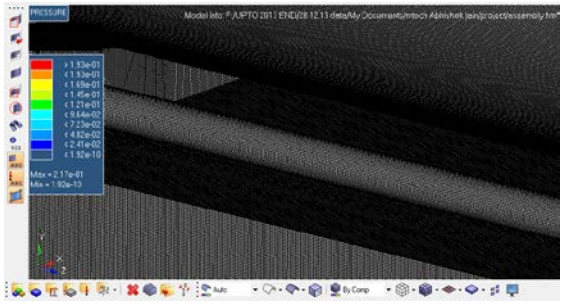

Fig. 2.7 - Pressure analysis in boiler drum with meshing

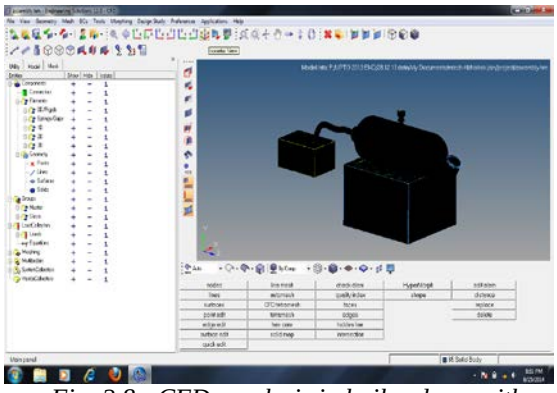

Fig. 2.8 - CFD analysis in boiler drum with meshing view

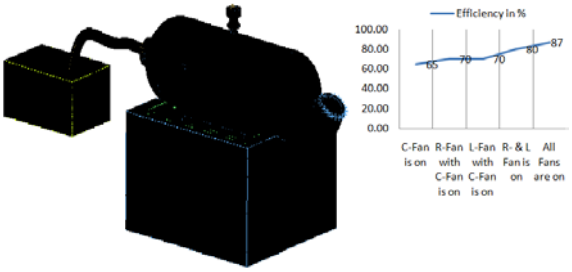

Fig. 2.9 - Curve between Combustion Efficiencies when blower fan is on.

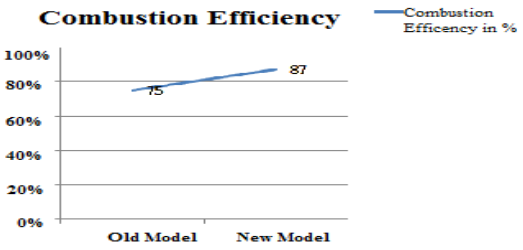

Fig. 2.10 - Combustion Efficiency Comparison between old model and New Model

New boiler combustion efficiency is 87% is higher than old model boiler drum efficiency which is 75%. So new boiler drum with radiator attachment is best for increasing boiler combustion efficiency.

III. SCOPE OF APPLICATIONS

Our boiler is basically a process boiler. In future we can work over Energy boiler by changing the shape and size of boiler shell, boiler tubes, furnace size, Flat panel radiator, etc. This will increase the rate of steam generation under the safety guidance by proper modelling and analysis. In our boiler steam generation capacity is about 9-10.25 tonnes per hour under the pressure of 17.25 kg/cm^2 under the all safety measures.

IV. CONCLUSION

The boiler was checked for its water flow, steam generation and heat loss within the allowable limits with maximum steam generation. The boiler was also checked for static conditions and was found safe. The water tube was checked for bending and strengths and was found under the limits of failures. The boiler chamber was checked for strength and was found safe. the radiator mechanism was designed in such a way that the maximum heat can reach to the water tube and was found able to transmit required heat from the furnace to the water tube. An appropriate structure is also proposed for boiler shell assembly resting. after checking all the above said items in many ways by using boiler calculation, heat loss calculation and flow in altair, we found that our boiler capacity to produce steam is up to 9 tph, pressure is up to 17.5 kg/cm^2.

V. REFERENCES

[1]. Enkata Seshendra Kumar Karri A Theoretical Investigation of Efficiency Enhancement in Thermal Power Plants Modern Mechanical Engineering,27 June [2012], 106-113 (2)

[2]. D.M. Farrell , B.J. Robbins , P. Sikka and M. Seaman on-line monitoring and control of furnace wall corrosion in pf-fired boilers [2011] Rowan Technologies Ltd, 216

[3]. Subodh Panda Bikash Swain Sandeep Mishra Blow down Losses Control in Thermal Power Plants Using Neural Network International Journal of Advancements in Research & Technology, Volume 2, Issue5, May[2013]

[4]. Genesis Murehwa, Davison Zimwara, Wellington Tumbudzuku, Samson Mhlanga Energy Efficiency Improvement in Thermal Power Plants International Journal of Innovative Technology and Exploring Engineering (IJITEE) December[2012] Volume-2, Issue-1

[5]. David Thornock Measurements and Design Enhancements in Fire tube Boilers Using Improved Technology.
[6]. N.P. Lieberman Oxygen removal from boiler water in high pressure boilers, Schenectady, NY 12345
[7]. P. N. Sapkal1, waste Heat Recovery BCS Incorporated March[2008]
[8]. Fleming Skovgaard Nielsen Modern boiler design January 2012
[9]. EsaK.Vakkilainen, Pekka Ahtila. Modern Method to determine recovery Boiler efficiency O PAPEL vol. 72, num. 12, pp. 58 - 65 DEC [2011]
[10]. Robert H, Sun J K, Melissa L. A kinetic model of carbon burnout in pulverized coal combustion. Combustion and Flame, 1998, 113(2): 181–197. [12] Bailey J G, Tate A, Diesel C F K. A char morphology system with applications to coal combustion. Fuel, 1990, 69(2): 225–239.
[11]. Rosenberg P, Petersen H I, Thomsen E. Combustion char morphology related to combustion temperature and coal petrography- phy. Fuel, 1996, 75(9): 1071–1082.
[12]. Cloke M, Wu T, Barranco R, et al. Char characterization and its application in a coal burnout model. Fuel, 2003, 82(16):
[13]. D. Feng, J. Liu, S. Li, P. Wang, K. Zhou and C. Huang, " Research on Obstacle Avoidance Based on Fuzzy Control for Inspection Robot in Oil Pipeline", IEEE International Conference on Information and Automation, June 2009, pp.189- 191.
[14]. H. P. Huang, J. L. Yan, and T. H. Cheng, "Development and Fuzzy Control of a Pipe Inspection Robot", IEEE Transaction on Industrial Electronic, Vol.57, No.3, March 2010, pp.1088-1095.
[15]. L. Shi and B. L. Guo, "RS485/422 solution in Embedded Access Control System," 2nd International Conference on Biomedical Engineering and Informatics, October 2009, pp. 1-4.
[16]. S. Xunwen, W. Shaoping, Z. Dongmei, and Z. Qishen, " RS-485 Serial Port Pseudo-full-duplex Communication Research and Application", Prognostics & System Health Management Conference, January 2010, pp.1-5.

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