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THERMAL ANALYSIS OF A HEAT EXCHANGER USING ANSYS

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ABSTRACT

In this paper, an interpreted model for the investigation of thermal analysis of shell and tubes heat exchangers of water and oil type is proposed. Shell and Tube heat exchangers are having uncommon significance in boilers, pre-heaters, condensers, oil coolers. They are broadly utilized as a part of process applications and also the refrigeration and cooling industry. The strength and medium weighted state of Shell and Tube heat exchangers make them appropriate for high pressure operations. In this paper we have demonstrated to done the warm examination by utilizing hypothetical formulae for this we have picked a pragmatic issue of counter flow shell and tube heat exchanger of water and oil type, by utilizing the information that originate from hypothetical formulae we have plan a model of shell and tube heat exchanger utilizing Pro-e and done the thermal analysis by utilizing ANSYS programming and looking at the outcome that got from ANSYS programming and hypothetical formulae.

Keywords: *Counter flow of shell and tube heat exchanger of oil and water type, ANSYS Software.*

I. INTRODUCTION

1.1 Heat exchanger

A device whose basic role is the exchange of energy between two liquids is named a heat exchanger. A heat exchanger might be characterized as equipment which exchanges the vitality from a hot liquid to a cool liquid, with greatest rate and least speculation and running expenses.

1.2 Shell and Tube Heat exchanger

In this kind of heat exchanger one of the liquids move through a heap of tubes encased by a shell. The external liquid is constrained through a shell and it flows over the outside surface of the tubes. Such a plan is utilized where unwavering quality and heat exchange adequacy. It is the most well-known type of heat exchanger in oil refineries and other extensive synthetic Processes, and is suited for higher-pressure applications. This Type of heat exchanger comprises of a shell (an extensive pressure vessel) with a heap of tubes inside it. One liquid goes through the shell to exchange heat between the two liquids.

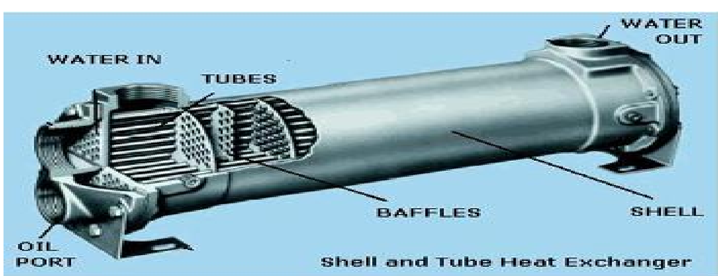

Fig 1: Shell and tube heat exchanger

Heat exchangers are one of the generally utilized equipment in the process industries. Heat exchangers are utilized to exchange heat between two process streams. One can understand their use that any procedure which includes heating, cooling, condensation, boiling or evaporation will require a heat exchanger for this reason. Process liquids, generally are heated or cooled before the process or experience a stage change. Distinctive heat exchangers are named by their application. For instance, heat exchangers being utilized to condense are known as condensers, correspondingly heat exchanger for boiling purposes for are called boilers. Performance and productivity of heat exchangers are estimated through the measure of heat exchange utilizing minimum zone of heat exchange and pressure drop. A better presentation of its efficiency is done by calculating over all heat transfer coefficient. Pressure drop and zone required for a specific measure of heat exchange, gives knowledge about the capital cost and power necessities (Running cost) of a heat exchanger. Usually, there is lots of literature and theories to design a heat exchanger as per the necessities.

Types heat exchangers are:-

1. Where both media between which heat is exchanged are in direct contact with each other is direct contact heat exchanger,
2. Where both media are separated by a wall through which heat is transferred so that they never mix, indirect contact heat exchanger.

A typical heat exchanger, more often than not for higher pressure applications up to 552 bars, is the shell and tube heat exchanger. Shell and tube type heat exchanger, aberrant contact type heat exchanger. It comprises of a series of tubes, through which one of the liquids runs. The shell is the compartment for the shell liquid. Generally, it is cylindrical in shape with a circular cross section, although shells of different shape are used in specific applications. For this specific investigation shell is considered, which is by and large a one pass shell. A shell is the most ordinarily utilized because of its low cost and simplicity, and has the highest log-mean temperature-contrast (LMTD) rectification factor. In spite of the fact that the tubes may have single or different passes, there is one pass on the shell side, while the other liquid streams inside the shell over the tubes to be heated or cooled. The tube side and shell side liquids are isolated by a tube sheet.

Objectives of the project

i) The purpose of this paper work is to design an Oil Cooler. Oil cooler is an essential equipment to cool the lube oil that is to cool the bearings and other surfaces of the large machinery like turbines.
ii) The type of heat exchanger applicable for the requirement is Shell and Tube Type with baffles for induced turbulence and higher heat transfer coefficient.

II. INTRODUCTION TO PRO/ENGINEER

Pro/ENGINEER, PTC's parametric, integrated **3D CAD/CAM/CAE solution**, is used by discrete manufacturers for mechanical engineering, design and manufacturing.

Created by Dr. Samuel P. Geisberg in the mid-1980s, Pro/ENGINEER was the industry's first successful parametric, 3D CAD modeling system. The parametric modeling approach uses parameters, dimensions, features, and relationships to capture intended product behavior and create a recipe which enables design automation and the optimization of design and product development processes.

This powerful and rich design approach is used by companies whose product strategy is family-based or platform-driven, where a prescriptive design strategy is critical to the success of the design process by embedding engineering constraints and relationships to quickly optimize the design, or where the resulting geometry may be complex or based upon equations. Pro/ENGINEER provides a complete set of design, analysis and manufacturing capabilities on one, integral, scalable platform. These capabilities include Solid Modeling, Surfacing, Rendering, Data Interoperability, Routed Systems Design, Simulation, Tolerance Analysis, and NC and Tooling Design.

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2.1 Models of heat exchanger

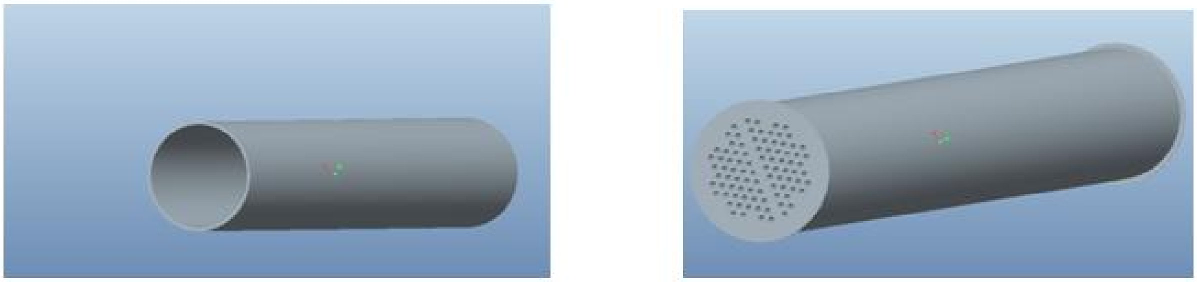

Fig 2: Model of Heat Exchanger without Baffles

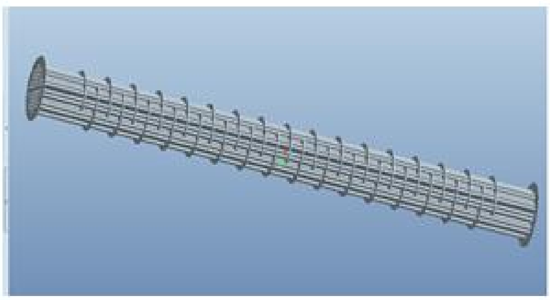

Fig 3: Model of Heat Exchanger with Baffles

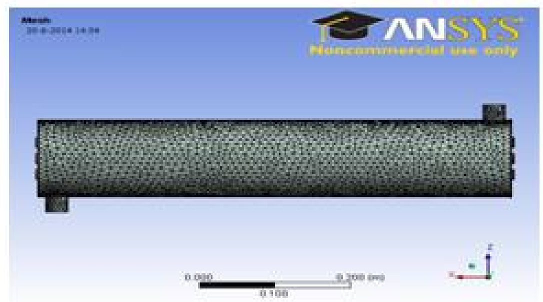

Fig 4: Meshing Model of Heat Exchanger

III. THERMAL ANALYSIS

Thermal analysis is a branch of materials science where the properties of materials are studied as they change with temperature. Several methods are commonly used - these are distinguished from one another by the property which is measured.

Thermal Analysis is also often used as a term for the study of Heat transfer through structures. Many of the basic engineering data for modeling such systems comes from measurements of heat capacity and Thermal conductivity.

3.1. Brass alloy with baffle

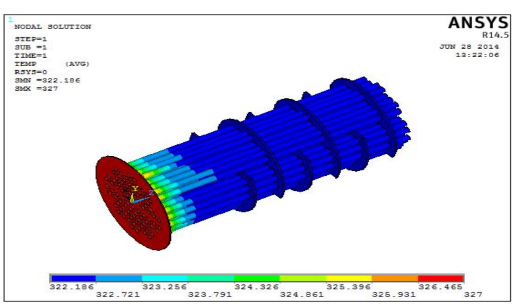

Fig 5: Nodal Temperature of Brass alloy with baffle

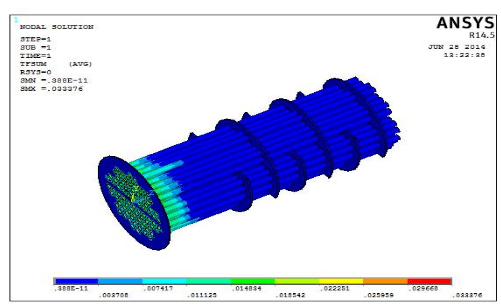

Fig 6: Total Heat flux of Brass alloy with baffle

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3.2 Stainless steel alloy with baffle

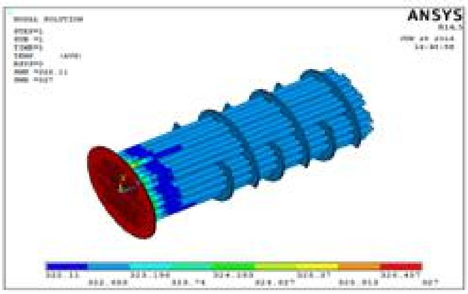

Fig 7: Nodal Temperature of Stainless steel alloy with baffle

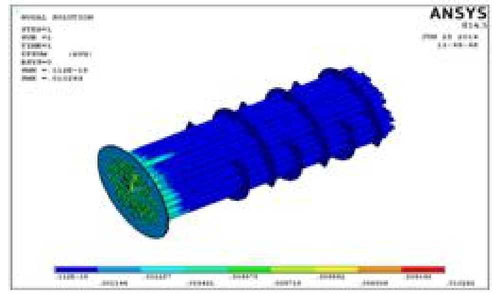

Fig 8: Total Heat flux of Stainless steel alloy with baffle

3.3 Carbon steel alloy with baffle

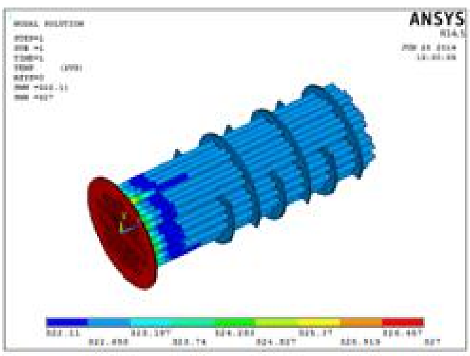

Fig 9: Nodal Temperature of Carbon steel alloy with baffle

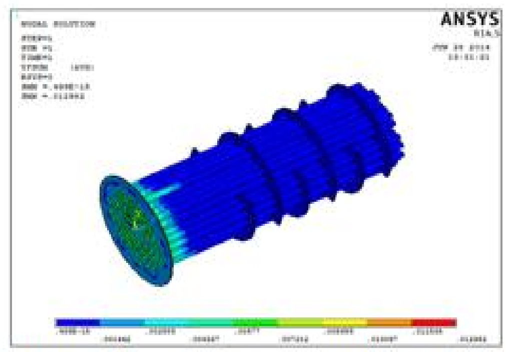

Fig 10: Total Heat flux of Carbon steel alloy with baffle

3.4 Nickel alloy with baffle

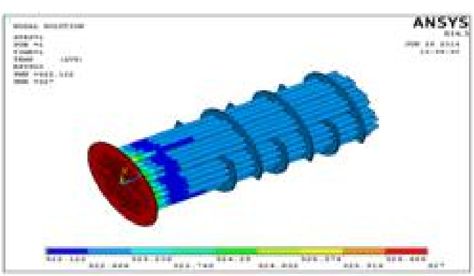

Fig 11: Nodal Temperature of Nickel alloy with baffle

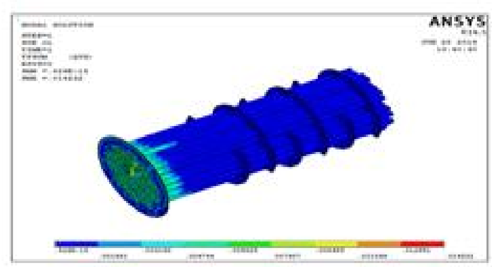

Fig 12: Total Heat flux of Nickel alloy with baffle

3.5 Brass alloy without baffle

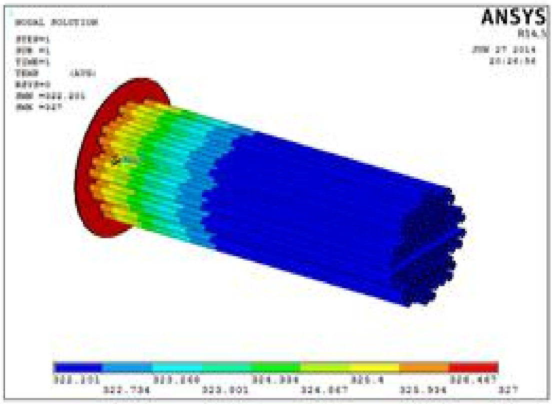

Fig 13: Nodal Temperature of Brass alloy without baffle

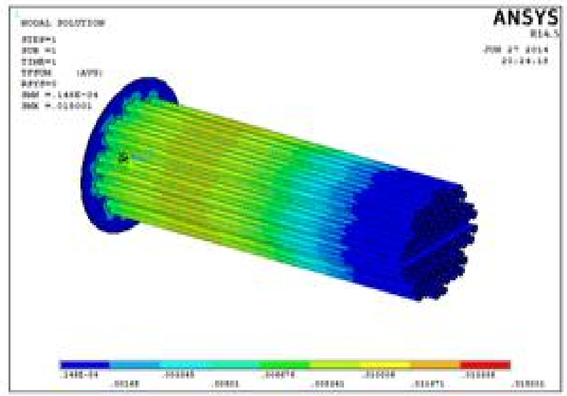

Fig 14: Total Heat flux of Brass alloy without baffle

3.6 Stainless steel alloy without baffle

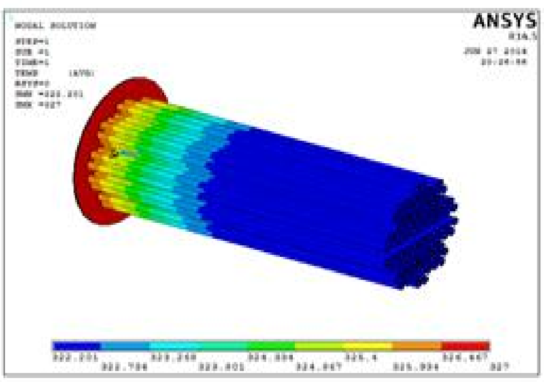

Fig 15: Nodal Temperature of Stainless steel alloy without baffle

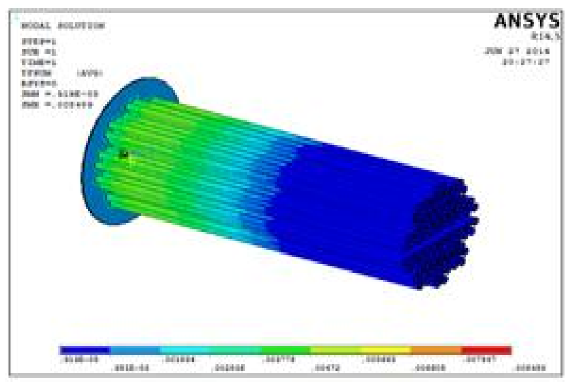

Fig 16: Total Heat flux of Stainless steel alloy without baffle

3.7 Carbon steel alloy without baffle

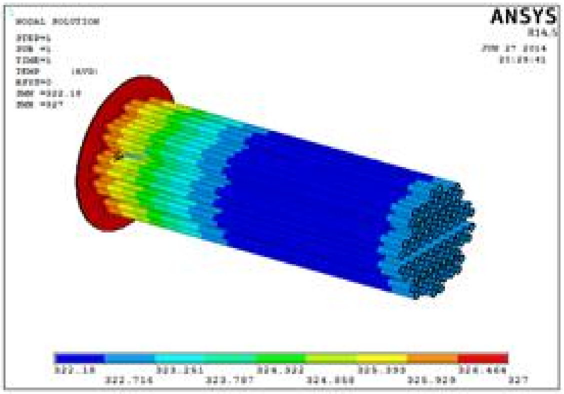

Fig 17: Nodal Temperature of Carbon steel alloy without baffle

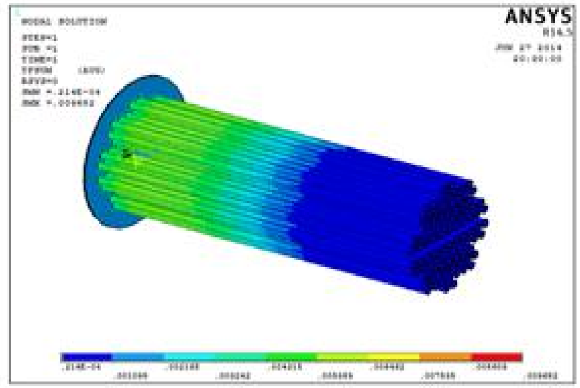

Fig 18: Total Heat flux of Carbon steel alloy without baffle

3.8 Nickel alloy without baffle

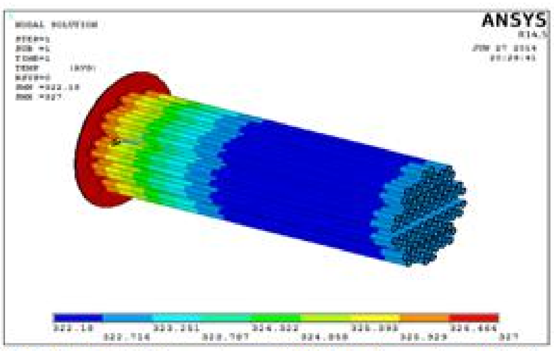

Fig 19: Nodal Temperature of Nickel alloy without baffle

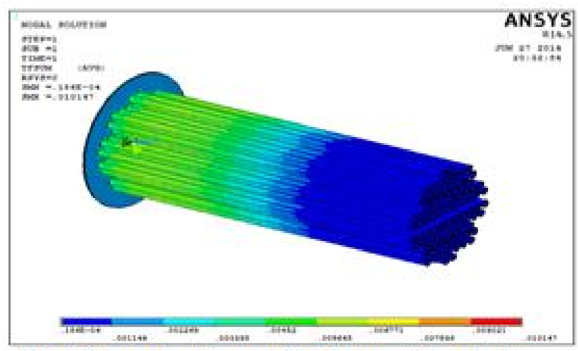

Fig 20: Total Heat flux of Nickel alloy without baffle

IV. CONCLUSION

In this paper work, a heat exchanger is designed and modeled in 3D modeling software Pro/Engineer. The heat exchanger is analyzed for without and with baffles, and thermal analysis is done on the heat exchanger for both the models using materials Nickel alloy, Brass, Carbon Steel and Stainless steel. Analysis is done in ANSYS.

By observing the thermal analysis result, the heat transfer rate is increased for heat exchanger with baffles.
By comparing the results for four materials, the stress is less and heat transfer rate is more when Brass is used.
So it can be concluded that using baffles for heat exchanger is advantageous.

REFERENCES

1. *Mirjana ,S LAKOVIC and Dejan D. MITROVIC (2010), Impact of the Cold End Operating Conditions On Energy Efficiency Of The Steam Power Plants, Vol. 14, Suppl., pp. S53-S66.*
2. *Ajeet Singh Sikarwar, Devendra Dandotiya, Surendra Kumar Agrawal (2013), Performance Analysis of Surface Condenser under Various Operating Parameters, International Journal of Engineering Research and Applications, Vol. 3, Issue 4,pp. 416-421.*
3. *Milan V. Sanathara, Ritesh P. Oza, Rakesh S. Gupta (2013), Parametric Analysis of Surface Condenser for 120 MW Thermal Power Plants, International Journal of Engineering Research &Technology,Vol. 2 Issue*

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Impact Factor- 5.070

3,pp.1-8.

4. *Amir vosough, Alirezafalahat, Sadegh vosough,Hasannasresfehani,Azambehjat and Royanaserirad (2011),Improvement Power Plant Efficiency with Condenser Pressure, International Journal of Multidisciplinary Sciences and Engineering, Vol. 2, No. 3, pp.38-43.*
5. *Ankur Geetea and A. I. Khandwawala (2013), Exergy Analysis of 120MW Thermal Power Plant with Different Condenser Back Pressure and Generate Correction Curves, International Journal of Current Engineering and Technology,Vol.3, No.1,pp.164-167.*
6. *Prashant Sharma, SPS Rajput and MukeshPandey (2011),Exergetic Optimization of Inlet Cooling Water Temperature of Cross Flow Steam Condenser, Emerging Technologies 2(1): 144-147 ISSN No. (Online):2249-3255.*
7. *A.Dutta, A. K. Das, S. Chakrabarti (2013), Study on the effect of cooling water temperature rise on loss factor and efficiency of a condenser for a 210 MW Thermal power Unit, Vol 3, Special Issue 3: ICERTSD 2013, pages 485-489.*
8. *Vosough Amir and Sadeghvosough(2011), Consideration the Important Factor to Power Plant Efficiency, International Journal of Multidisciplinary Sciences and Engineering ,Vol. 2, No. 9,pp.56-59.*
9. *A.N. Anozie, O.J. Odejobi, "The search for optimum condenser cooling water flow rate in a thermal power plant", applied thermal engineering (31) pp. 4083-4090, 2011.*
10. *Mirjana S. Lakovic, Mladen M. Stojiljkovic, Slobodan V. Lakovic, Velimir P. Stefanovic, Dejan D. Mitrovic, "Impact of the cold end operating conditions on energy efficiency of the steam power plants", Journal of thermal science, Vol. 14, pp. S53-S66, 2010.*