International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

# COPY RIGHT



IJIEMR Transactions, online available on 19th Nov 2017. Link :http://www.ijiemr.org/downloads.php?vol=Volume-6&issue=ISSUE-11

Title: **THERMAL ANALYSIS OF A HEAT EXCHANGER USING ANSYS**

Volume 06, Issue 11, Pages: 204–210.

Paper Authors

**V.CHAITANYA KRISHNA, MR.B.NARASIMHA**

Brilliant grammar school educational institutions group of institutions integrated campus, T.S, India


USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

# THERMAL ANALYSIS OF A HEAT EXCHANGER USING ANSYS

[1]V.CHAITANYA KRISHNA, [2]MR.B.NARASIMHA
[1] M.Tech Student, Dept of Mechanical-THERMAL, Brilliant grammar school educational institutions group of institutions integrated campus, T.S, India
[2]Assistant Professor, Dept of Mechanical-THERMAL, Brilliant grammar school educational institutions group of institutions integrated campus, T.S, India

## ABSTRACT

In this project, an easy design for the report of thermal Investigation of shell with tubes heat exchangers of water and oil form is suggested. Shell with Tube heat exchangers are carry main requirement in pre-heaters, oil coolers. These are also rarely required in working industries like the refrigeration and wind conditioning. The robustness and light weighted shape of Shell with Tube heat exchangers made them better settled for maximum pressure requirements. In this we have shown how to done the thermal Investigation by the requirement of analytical formulae for that we take selected a practical trouble of counter flow shell with tube heat exchanger of water and oil form, with help of the statistics that given from mathematical formulae we could develop a model of shell with tube heat exchanger by Pro-E and completed the thermal Investigation by the use of ANSYS software and match the result that given against ANSYS software & mathematical formulae.Oil cooler is an important machinery to cool the lube oil that is to cool the bearings and remaining surfaces of the big machinery same turbines

## 1.0 INTRODUCTION

An Equipment whose important use is the Shift the energy among 2 liquids is called as heat exchanger. A heat Exchanger could also be transfer as a system that shifts the energy between hot fluid & cool liquid, with most rate and less investment & running prices.

### Shell and Tube Heat exchanger

For this way heat exchanger 1 of the fluids flows along the bunch of tubes penned by a shell. The outer or surrounding fluid is forced through a shell & it flows above the skin place of the tubes, such a meeting wherever dependableness and effectiveness of heat transfer. It's the foremost common s tyle of device in oil Industries & different giant chemical methods, & is important for higher-pressure operations. This way heat exchanger having a shell (a giant pressure vessel) with a bunch of tubes along within it. Single of the liquid flows above the shell to shift heat among the 2 fluids.

Shell and Tube Heat Exchanger way of Water to Oil

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

## OPERATIONS OF HEAT EXCHANGER

Open the water Entrance valve & open the air vent lock on the water box cover. Close the air vent when there a steady vapor of water from the vent. Open oil entrance and exit of the cooler and vent the oil side completely as before. When the temperature of the oil at the closing from the cooler has reached the given value, regulates the flow of working water through the cooler by adjusting the outlet valve.To take the stand-by cooler into operation, On waterside operate the stand-by cooler as before. Now open the changeover valve to bring the oil way of the stand-by cooler into operation and shut down the oil way of the running cooler. For closing down running cooler, close oil outlet, closing water outlet, oil inlet and finally closing water inlet in that order.

## ADVANTAGES OF HEAT EXCHANGER

1. Effectiveness of cooling is more for the area of cross rate is more.
2. Percentage of drop pressure is low.
3. Coefficient of heat transfer is more.
4. Tubes are readily required in indigenous market.
5. Replacement of tube incase of tube failure is very easy.
6. Maintenance amount of the cooler is easy.

## 2.0 LITERATURE REVIEW

**1."Impact of the cooling end operating requirments on energy performance of the stream power plants"** Mr. Mirjana, Mr. S LAKOVIC and Mr. Dejan D. MITROVIC in 2010 targeted on impact of cold water temperature on energy efficiency of power plant, increasing pressure within the condenser of 1 kPa, performance is reduced to 1.0-1.5% using Simulator support. Heat transfer rate and pressure within the condenser area unit given for variable cooling water temperature and rate, the particular heat rate modification as a conclusion of the modification of compression pressure, and final the heat energy rate modification as a conclusion of the cold water action. At the end, the variation in condenser pressure is the main work of the reference plant for energy efficiency.

**2. "Performance Calculation of the surface condenser below different operating parameters"** Mr. Ajeetsingh Siarwar , Mr. DevendraDandotiya and Mr. S.V. Agrawal in 2013 Complete Study of the factors or elements which decrease the efficiency of the condenser with the Investigation of ATPS & concluded that three factors which decreasing the Performance of the condenser those are deviation due to entrance temperature of cold water , deviation as a conclusion of cold liquid flow, change because of the air ingress and dirty Tubes, finalized from the above study, the efficiency of the energy plant will decrease to 0.4% with these deviations within the condenser.

**3. "Parametric Investigation of surface condenser for 120 MW thermal power plants"** Mr. Milan V.Sanathara, RiteshP.Oza and Mr. Rakesh.Guptain 2013 Complete the study on the relation among the cold liquid flow rate , temperature and condenser efficiency. This relation could be concluded with the Parametric Analysis

Method. First author calculated the specific heat rate flow of the coal fired plant & its energy performance. Vacuum inner the condenser is change with the Cooling water. This Enhanced condenser pressure can lower the power efficiency of Less Pressure turbine. From the Equations and Investigation writer provide that if the cold liquid entrance temperature will increases, the efficiency of the condenser is reduced.

4. **"power plant efficiency with condenser pressure"** Mr. Amir vosough, Alirezafalahat, Sadeghvosough, Hasannasresfehani,Azambehjat and Royanaseri radin 2011 to identify and quantify the sites having maximum energy & exergy losses at cycle Using Energy & Exergy calculation Method. Additionally, the risk of changing the condenser pressure on this calculation will also be shown with the ranges of turbine & condenser temperatures. This model used the less allowable condenser pressure to improve the maximum performance and outlet power. This minimum pressure must be continually controlled throughout the power plant operation. The maximum energy discharge was calculated in the condenser where only 60.86% of the given energy was lost to the weather. The exergy destruction within the condenser have 13.22% & heat and exergy performance 38.39 %.

5.**An adept model for the shell & tube heat exchanger Investigation by Artificial Neural Networks**, Mr. A.R. Moghadassi, Mr. S.M. Hosseini, F. Parizian, F. Mohadiyon, A. BehzadiMoghadamand A. Sanaeirad, Heat exchangers analysis & heat translate Equations are preceded because of the more usefulness of the heat exchangers in chemical & petro chemical industries. Heat translate formula for the analysis & choice of shell & tube heat exchanger depends on the obtained pressure drop & fouling factor next consecutive equations. The conventional and removal processes (such as KERN way etc) are presented. Also those are more properties & parameters in prevalent methods. The todays work proposed a modern method with the advice of the artificial neural network (ANN) for the Investigation of Shell & Tube Heat Exchangers. Important specifications for heat exchangers Investigation were got by this neural network & the required to the experimental statistics were possessed form Kern's book, TEMA and Perry's handbook. The work worn back- propagation Information algorithm incorporating levenberg- marquardt improving process. The efficiency & trend strength of the trained networks were checked in line with their ability to predict unseen information. MSE mistakes evaluation was used and the mistakes limitation is 10-3-10-6. Parameters can be finded without using charts, different tables and complicated equations. Twenty two networks were used for all different properties throughout the research. The ANN's were demonstrated the conclusions capacity to prefer the research analysis.

## 3.0 DESIGN AND METHODOLOGY

### 3.1 Material and Method

**Surface Condenser Design**

To design surface condenser below input required & necessary,

- Ambient Pressure & Temperature
- Relative Humidity

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

- Design requirements at distinctive Gas Turbine Load Inlet of Steam (kg/s)
- Inlet of Steam (kg/s)
- Condensate Output Temperature ($^0$C)

**Thermal Design**

It is an important and first model of heat exchanger, In this we optimize the model by varying flow rate, material thermal conductivity etc. By changing the design of 2 or 3 pass system can also we optimized in process. same to the HEI-standards Turbine Condensers are modeled for vapor condensers (HEI means Heat Exchange Institute) Since 1933 - HEI is the nonprofit trade federation decided to the technical advancement, promotion, developing & study of industrial heat exchanger, vacuum system etc. HEI has designed and published Standard: journal article **MECHANICAL DESIGN & CONSTRUCTION CODE**

Mechanical Design & Construction Code

**Construction Data**

Tube outside diameter ------------------------------------------------- 19.05 mm

Thickness of wall Tube----------------------------------------------------- 1.65 mm

No. of tubes--------------------------------------------------------------- 90

No. of Water passes--------------------------------------------------------- 1

Effective each tube length, ------------------------------------------- 3190 mm

Overall Length ----------------------------------------------------------- 3300 mm (approx.)

Shell internal diameter, ------------------------------------------------- 323.8 mm

Capacity of hot well, -------------------------------------------------1.28 $m^3$ (2minutes)

Total weight ------26679/38146/61332 (approx.), kg (empty, operating, flooded)

**Physical strength design**

Design/ Test pressure, Steam side, ----------------------- 1.1 & FV/ water fill kg/cm$^2$ (g)

Design / Test pressure, Water side, ----------------------- 5 / 6.5 kg/cm$^2$ (g)

Design temp. Shell/tube side, ----------------------------- 120 / 80° C

Rust allowance on shell & channel shell side----- 1.6 mm on CS portion

**Materials of construction**

Tubes-------------------------------------------------------- SA 249 TP. 304

Tube Sheets--------------------------------------------------IS 2062

Shell---------------------------------------------------------IS 2062

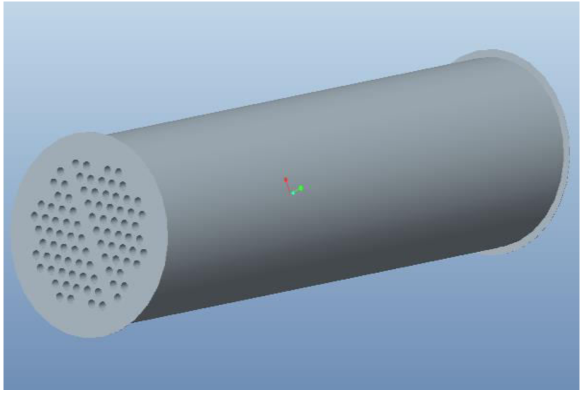
Tube support plates-----------------------------------------IS 2062

Water boxes-------------------------------------------------IS 2062

Pipes-------------------------------------------------------- SA106 Gr. B

Fasteners----------------------------------------------------SA 193-B7 / SA 194-2H

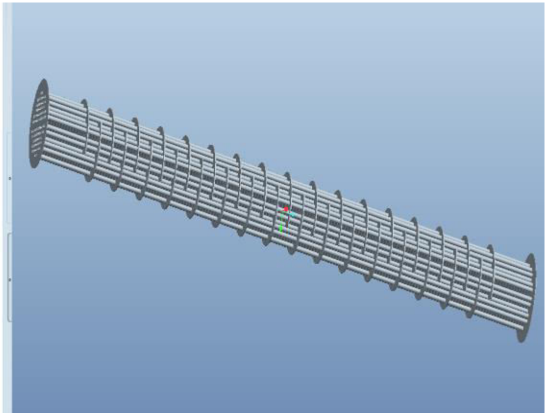
Gasket------------------------------------------------------- Rubber



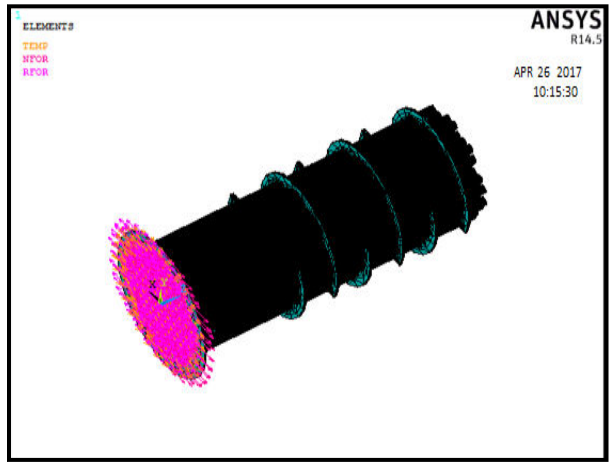
Models with Heat Exchanger not with Baffle

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

**ALONG WITH BAFFLES**



Model with Heat Exchanger by Baffles

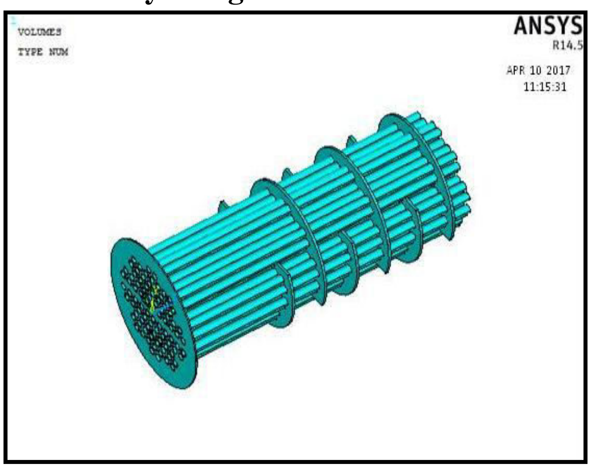



Temperature Distrubution of a heat exchanger by baffles

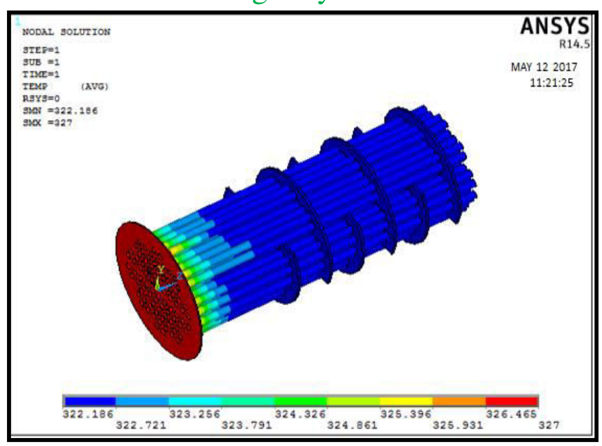
## 4.0 RESULTS:

## THERMAL ANALYSIS METHOD

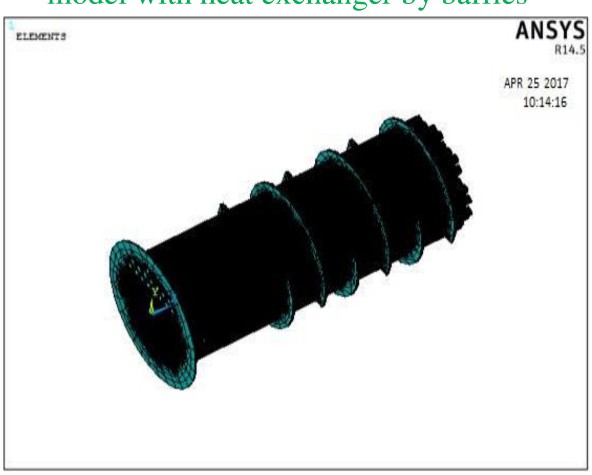
**Brass Alloy along with Baffle**




model with heat exchanger by baffles

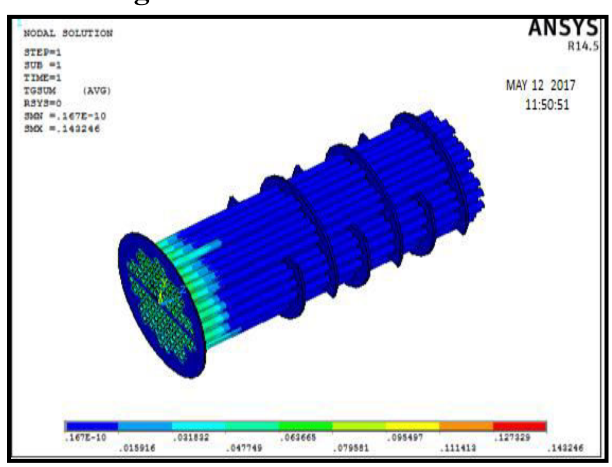



Nodal Temperature of a heat exchanger along with baffles




model of heat exchanger by baffles after meshing

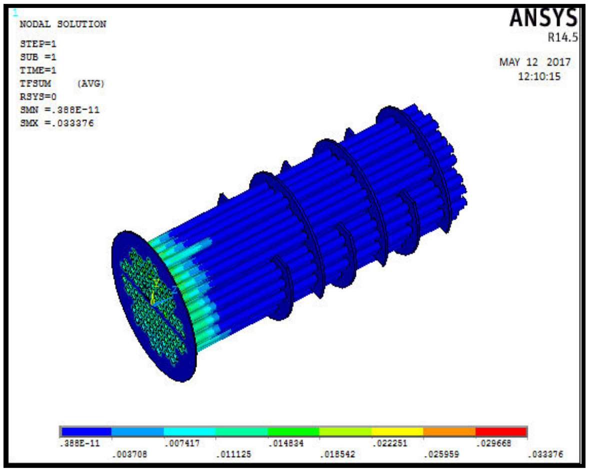
**Thermal gradient**




Thermal gradient of a heat exchanger along with baffles

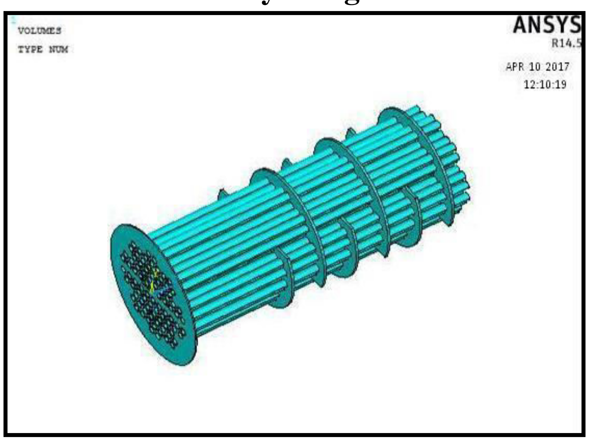
International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

**Thermal flux**



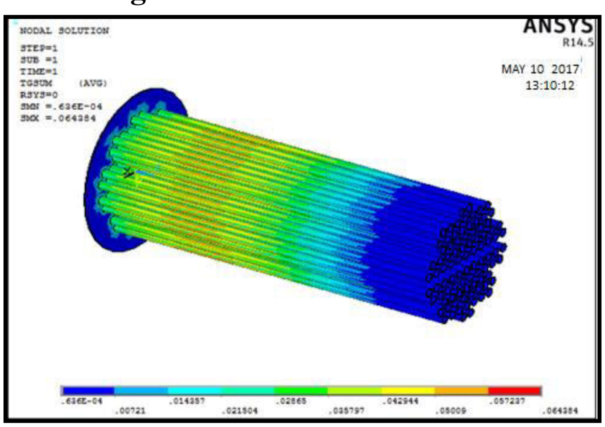

Thermal flux of a heat exchanger along with baffles

**Stainless Steel Alloy along with Baffles**



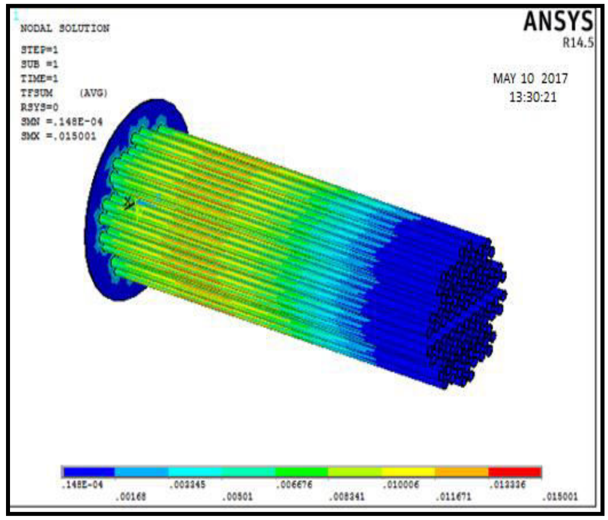

model of heat exchanger by the baffles

**Thermal gradient**




Thermal gradient of a heat exchanger not with the baffles

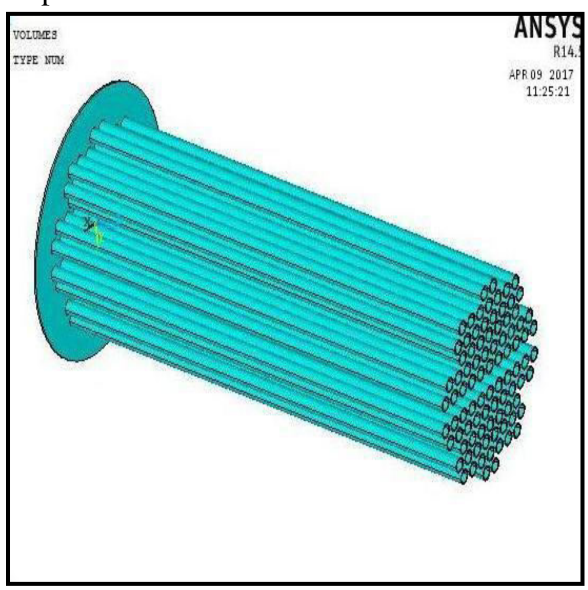
**Thermal flux**




Thermal flux of heat exchanger not with the baffles

**Stainless Steel Alloy Not with Baffles**

Imported Model




model of heat exchanger not with the baffles

Element Type: solid 20 nodes 90

Material Properties: Thermal conductivity = 0.0343

Specific heat = 620

Density =0.0000019kg/mm$^3$

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Meshing>mesh tool>smart sizes on>mesh>pick all>ok
Meshed model

## 5.0 CONCLUSION

In View of this project, a heat exchanger is created and modeled in 3 Dimensional programing computer software Pro/Engineer. The heat exchanger is analyzed for without and with baffles. Thermal and Structural Investigation is completed on the heat exchanger for the models using materials Brass, carbon steel and Stainless steel. Investigations using ANSYS.Observing the structural Investigations results, the displacement & stresses are small with baffles than the without baffles. By observing the thermal Investigation result, the quantity of heat transfer more for heat exchanger along baffles.Balance the results of three materials, the quantity of heat transfer more for Brass without baffles when compared to carbon steel and Stainless steel with baffles. So it could be decided that with baffles heat exchanger are advantageous.

## REFERENCES

**1.**Ajeet Singh Sikarwar, DevendraDandotiya, Surendra Krishna Agrawal (2013), Performance Study of Surface Condenser below numerous operational Parameters, *universal Journal of manufacturing analysis and Applications,* Vol. 3,

**2.** Prashant Sharma, SPS Rajpoot and MukeshPandey (2011),Exergetic Optimization of recess Cooling Water Temperature of Cross Flow Steam Condenser, rising Technologies

**3.**Vosough ruler and Sadeghvosough(2011), The Important Factor to Power Plant Efficiency, *International Journal papers of Multidisciplinary Information and Engineering* ,Vol. 2

**4.** A.N. Anozie, O.J. Odejobi, "The explore for maximum condenser cold water flow rate in a vapor power plant", applied thermal engineering.

**5.**Mirjana S. Lakovic, Mladen M. Stojiljkovic, Slobodan V. Lakovic, Velimir P. Stefanovic, Dejan D. Mitrovic, "Impact of the cold end operating settings on energy potency of the steam power plants", Journal of warm science, Vol. 14

**6.** NirmalkumarP.Bhatt, B. A. M. Lakdawala, C. V. J. Lakhera, "Steam Surface Condenser Style supported value Optimization using Genetic Algorithm", international conference on current movements in technology, „NUiCONE", 2011.

**7.** M.E. El-Dahshan, Liufu Wang, A.M. Sham El Din, Badr Bin Ashoorb, "A new type of titanium condenser pipe droplet erosion", Journals of chemical action..

**8.** T. Murase, H.S. Wang, J.W. Rose, "Reaction of torrent for condensation of vapor on easy and Increased condenser tubes", world Journal of warmth and Matter Transfer.

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

International Journal for Innovative
Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org