Exergy Analysis On Shell & Tube Type Heat Exchanger

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Abstract

Energy consumption is the most important problem in the present day. The energy analysis gives only energy consumption and energy losses of systems. It does not provide information about internal inefficiency of equipment. The exergy analysis, when applied to process or a whole plant tells us how much is the usable work potential or exergy supplied as input to the system & consumed by process or plant.Unequal duration of the active and passive phases of the heat source, and consequently of the heat storage and discharge, is allowed. We have take all parametric data related to heat exchanger taken from NIRMA LTD Bhvnagar.After exergy analysis of shell and tube type heat exchanger We are to follow standard procedure for measuring exergy which I can get from reference paper which is related to exergy. I validate the reference paper related to exergy & getting exergy measuring data. we have analysis after exergy measure In this project taking cooling water inlet temperature 300 K & cooling water outlet temperature is 314 K and 1.7 bar pressure there are exergy is 25904.7 KW at a time efficiency is 30.0007% Take cooling water inlet temperature 302.1 K & cooling water outlet temperature is 315.5 there are exergy is 24002.9 KW at a time efficiency is 30.0256%.Take cooling water inlet temperature 302.9 K & cooling water outlet temperature is 316.1 there are exergy is 23356.2 KW at a time efficiency is 30.0782%.We have conclude that inlet
Keywords: Exergy, Shell & tube type heat exchanger,Efficiency,Temperature

I. INTRODUCTION

A heat exchanger is a piece of device to efficient heat transfer from one medium to another. There is media may be separated by a solid wall to prevent mixing or they may be in direct contact type. They are used in widely like as a space heating, refrigeration effect, air conditioning system, power plants, chemical factory, petrochemical plan, petroleum refineries system, natural gas processing system, and sewage treatment plant. The mainly example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as engine coolant flows through radiator coils and air flows past the coils, which cooling the coolant and heating the incoming air

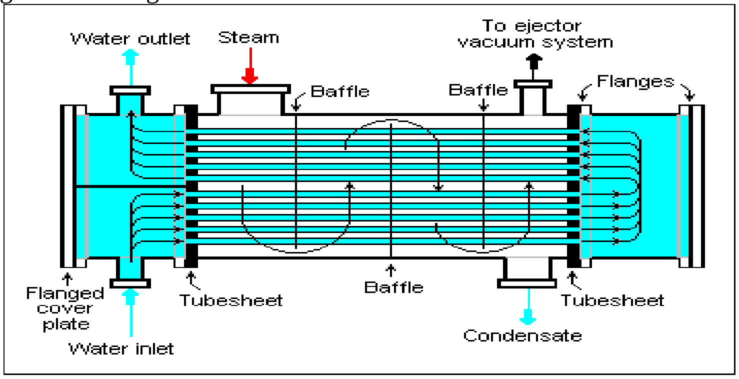

Fig. 1: Shell and Tube Type Heat Exchanger

A shell and tube heat exchanger is a which type of heat exchanger designs. It is the mostly common type of heat exchanger in oil refineries factory and other large chemical processes factory, and is suited for higher-pressure applications. As its name implies, this type of heat exchanger consists of a shell (a large pressure vessel) with a bundle of tubes inside the shell. One fluid runs through the tubes, and another fluid flows over the tubes (through the shell) to transfer heat between the two fluids or each other. The set of tubes is called a tube bundle, and may be composed of several types of tubes like as a plain, longitudinally finned, etc

II. EXERGY ANALYSIS METHODOLOGY

We are going to exergy analysis validation following procedure which get from reference paper.

$E_X = (H-H_0) - T_0(S-S_0)$ [8]

H = Enthalpy of system.
S = Entropy of system.
T = Temperature of system.

(1) Exergy Analysis

$E = m_v[c_{pv}[(t_{v1}-t_{v2})-t_o*\ln(t_{v1}/t_{v2})]+h_{fg}-to*s_{fg}]-(m_c*c_{pc})*[(t_{c2}-t_{c1})-t_o*\ln(t_{c2}/t_{c1})]$

(2) Efficiency

$n_{ex} = [(t_{c2}-t_{c1})-t_o*\ln(t_{c2}/t_{c1})] \;/\; [m_v[c_{pv}[(t_{v1}-t_{v2})-t_o*\ln(t_{v1}/t_{v2})]+h_{fg}-to*s_{fg}]]$

Where,

$m_v(e_2- e_1)= [m_v[c_{pv}[(t_{v1}-t_{v2})-t_o*\ln(t_{v1}/t_{v2})]+h_{fg}-to*s_{fg}]$

$m_c(e_{v1}- e_{v2})= [(t_{c2}-t_{c1})-t_o*\ln(t_{c2}/t_{c1})]$

Specification

c_{pv} = Specific heat of vapour , kJ/kg K (2.718)
c_{pc} = Specific heat of water , kJ/kg K
m_v = Mass flow rate of vapour kg/s
m_c = Mass flow rate of colling water kg/s
t_{v1}= Inlet vapour temperature K
t_{v2} = Outlet vapour temperature K
t_{c1} = Inlet colling water temperature K
t_{c2} = Outlet colling water temperature K
t_0 = Dead state/environment temperature (25^0c)
E = Exergy rate, kW
n_{ex} =Exergy efficiency
h_{fg} = Enthalpy of Condensation kj/kg
s_{fg} = Entropy of Condensation kj/kg

Table – 1
All Parameter Data Related To Heat Exchanger

M_v	T_{v1}	T_{v2}	H_{fg}	S_{fg}	M_c	C_{pc}	T_{c1}	T_{c2}	*Exergy*	*Efficiency*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*284*	*313*	*16145.78*	*4.7982274*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*285*	*313*	*14647.46*	*13.632908*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*286*	*313*	*13264.98*	*21.784529*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*287*	*313*	*11997.54*	*29.257858*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*288*	*313*	*10844.33*	*36.057615*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*289*	*313*	*9804.566*	*42.188468*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*290*	*313*	*8877.461*	*47.655038*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*291*	*313*	*8062.239*	*52.4619*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*292*	*313*	*7358.134*	*56.61358*
147.2	*433*	*306*	*2423.6*	*7.916*	*7500*	*4.21*	*293*	*313*	*6764.385*	*60.114556*

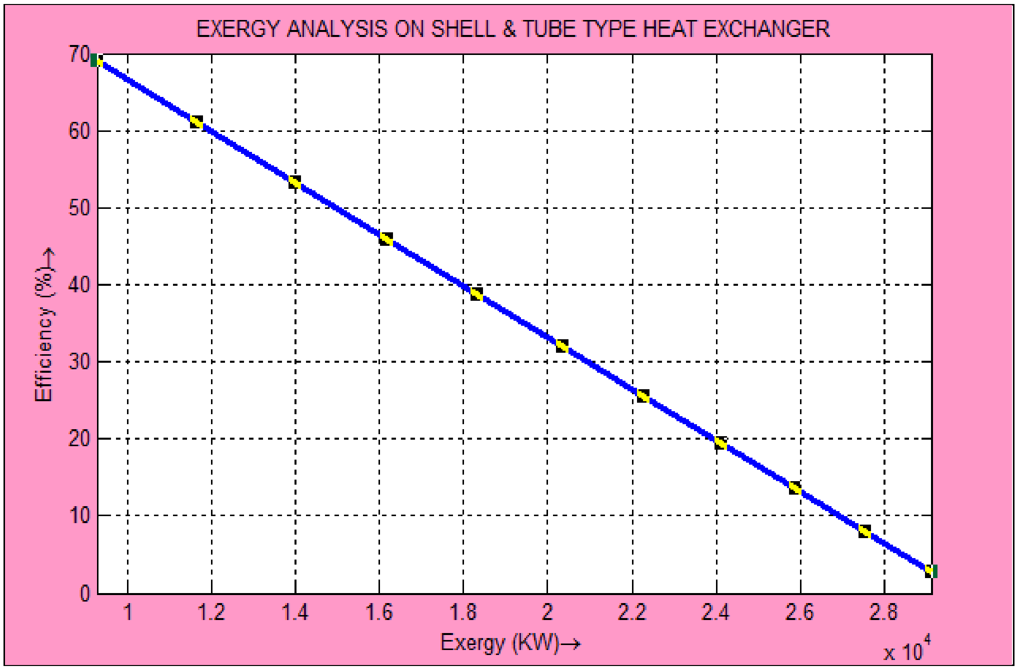

Fig. 2: Efficiency / Exergy Graph

III. RESULT

This project EXERGY analysis shell and tube type heat exchanger in NIRMA LTD Bhavnagar &efficiency is 30%.

Table – 2
All Parameter Data Related To Heat Exchanger

M_v	T_{v1}	T_{v2}	H_{fg}	S_{fg}	M_c	C_{pc}	T_{c1}	T_{c2}	*Exergy*	*Efficiency*
215	*346*	*316*	*2390.1*	*7.466*	*5500*	*4.21*	*300*	*314*	*25904.7*	*30.0007*
215	*346.5*	*316.3*	*2392.5*	*7.497*	*5500*	*4.21*	*300.4*	*314.2*	*25703.3*	*30.0018*
215	*347.1*	*316.8*	*2389.1*	*7.467*	*5500*	*4.21*	*300.6*	*314.6*	*25302.5*	*30.0065*
215	*347.8*	*317.1*	*2388.9*	*7.528*	*5500*	*4.21*	*301.1*	*314.9*	*24900.2*	*30.0089*
215	*348.2*	*317.2*	*2387.3*	*7.559*	*5500*	*4.21*	*301.6*	*315.1*	*24504.4*	*30.0124*
215	*348.6*	*317.9*	*2385.5*	*7.497*	*5500*	*4.21*	*302.1*	*315.5*	*24002.9*	*30.0256*
215	*348.9*	*318.2*	*2384.1*	*7.469*	*5500*	*4.21*	*302.7*	*315.8*	*23500.5*	*30.0467*
215	*349.2*	*318.6*	*2383.9*	*7.328*	*5500*	*4.21*	*302.9*	*316.1*	*23356.2*	*30.0782*
215	*349.4*	*319.1*	*2382.1*	*7.469*	*5500*	*4.21*	*303.6*	*316.2*	*23200.2*	*30.0921*
215	*349.8*	*319.2*	*2381.5*	*7.498*	*5500*	*4.21*	*303.9*	*316.7*	*23003.3*	*30.1043*
215	*350.1*	*320.1*	*2381.1*	*7.566*	*5500*	*4.21*	*304.2*	*317.3*	*22001.1*	*30.4287*

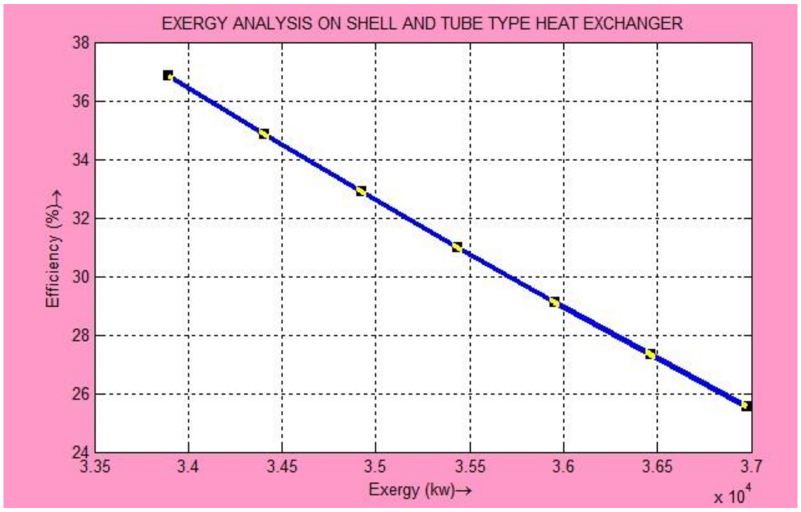

Fig. 3: Efficiency/Exergy

IV. CONCLUSION

In this project taking cooling water inlet temperature 300 K & cooling water outlet temperature is 314 K and 1.7 bar pressure there are exergy is 25904.7 kw at a time efficiency is 30.0007% Take cooling water inlet temperature 302.1 K & cooling water outlet temperature is 315.5 there are exergy is 24002.9 kw at a time efficiency is 30.0256%. Take cooling water inlet temperature 302.9 K & cooling water outlet temperature is 316.1 there are exergy is 23356.2 kw at a time efficiency is 30.0782%. Take cooling water inlet temperature 303.6 K & cooling water outlet temperature is 316.2 there are exergy is 23200.2 kw at a time efficiency is 30.0921%. Take cooling water inlet temperature 304.2 K & cooling water outlet temperature is 317.3 there are exergy is 22001.1 kw at a time efficiency is 30.4287. Also show in MATLAB programming graph curve change to related to all parameter.Now conclusion there are getting maximum inlet temperature there are exergy is decrease at a that time efficiency increase also shown in graph.

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