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Exergy Analysis On Shell & Tube Type Heat Exchanger

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Abstract— 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. Take all data fromNIRMA LTD BHAVNAGAR,& SIKA POWERPLANT. After Calculation all data than there are tcond increase exergy is decrease and efficiency is increase Tcond change 306 to 307 there are exergy is 16145.77 to 15732.97 there are efficiency increase to 8% Now Tcond 309 to 310 exergy is 15251 to 15239 there are efficiency 4.1% Now also Tcond 313 to 314 there are exergy 15610 to 15941 to increase efficiency 1.2%. All Data calculate Theoretical and compare with all data Using MATLAB Software

Key Words: Exergy, Shell & tube type heat exchanger,Efficiency,Temperature

I. INTRODUCTION

A heat exchanger is a piece of equipment built for efficient heat transfer from one medium to another. The media may be separated by a solid wall to prevent mixing or they may be in direct contact.

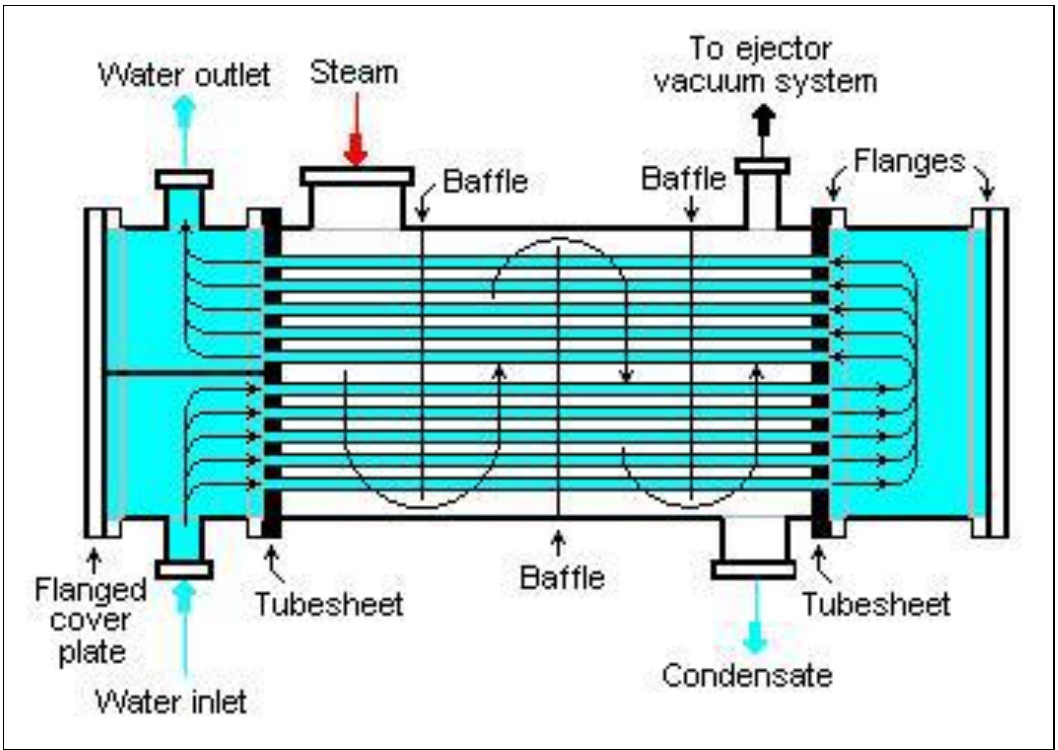

Figure 1. *Shell and tube type heat exchanger*

As its name implies, this type of heat exchanger consists of a shell (a large pressure vessel) with a bundle of tubes inside it. One fluid runs through the tubes, and another fluid flows over the tubes (through the shell) to transfer heat between the two fluids. The set of tubes is called a tube bundle, and may be composed of several types of tubes: plain, longitudinally finned, etc.

1.1 Exergy

The maximum useful work that can be obtained from a system at a given state in a given environment; in other words, the most work you can get out of a system. The term "exergy" was coined in 1956 by Zoran Rant (1904– 1972) by using the Greek ex and ergon meaning "from work", but the concept was developed by J. Willard Gibbs in 1873. Exergy analysis is performed in the field of industrial ecology to use energy more efficiently. Engineers use exergy analysis to optimize applications with physical restrictions, such as choose the best use of roof space for solar energy technology Ecologists and design engineers often choose a reference state for the reservoir that may bedifferent from the actual surroundings of the system.

II. Methodology

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

EX = (H-H0) – T0(S-S0)
H = Enthalpy of system.
S = Entropy of system.
T = Temperature of system.

(1) Exergy Analysis
Exergy=mv[cpv[(tv1-tcond)-to*ln(tv1/tcond)]+hfgto*sfg]-(mc*cpc)*[(tc2-tc1)-to*ln(tc2/tc1)]

(2) Efficiency
[(tc2-tc1)-to*ln(tc2/tc1)]/[mv[cpv[(tv1-tcond)-to*ln(tv1/tcond)]+hfg-to*sfg]]

cpv=Specific heat of vapour , kJ/kg K
cpc= Specific heat of water , kJ/kg K
mv= Mass flow rate of vapour kg/s
mc= Mass flow rate of colling water kg/s
tv1= Inlet vapour temperature K
tv2= Outlet vapour temperature K
tc1= Inlet colling temperature K
tc2= Outlet colling temperature K
t0= Dead state/environment temperature,K
E= Exergy rate, kW
ηex= Exergy efficiency
hfg= Enthalpy of Condensation kj/kg
sfg= Entropy of Condensation kj/kg

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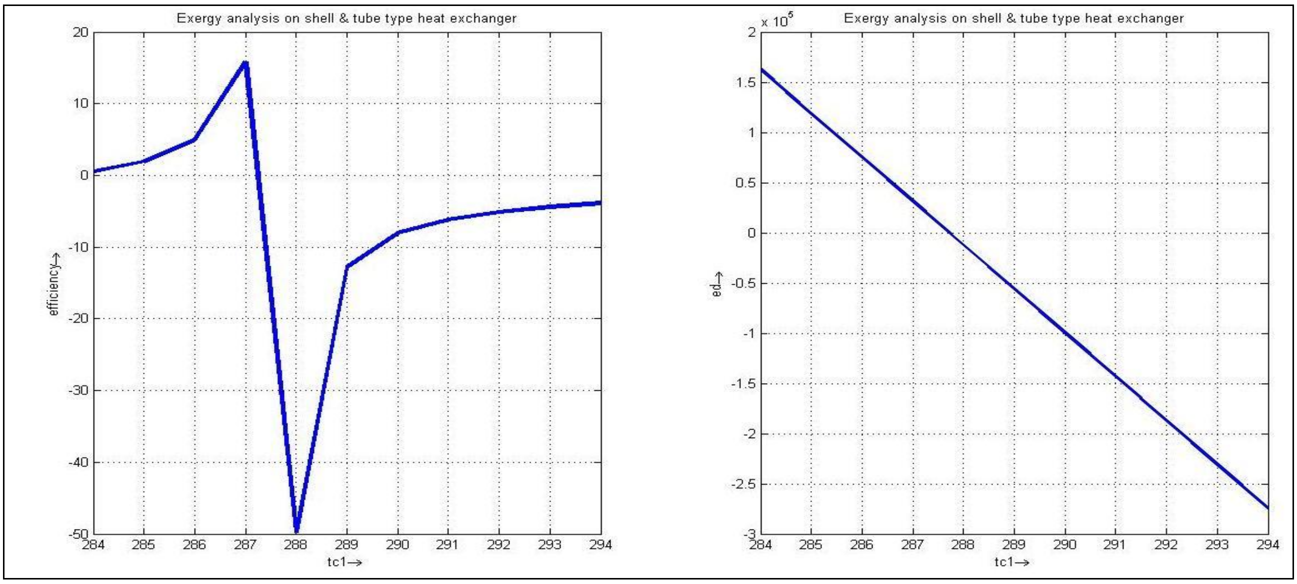
Table no 1: Calculating Data

tv1	tcond	tc1	tc2	Exergy	EFFICIENCY
433	306	284	313	16145.776	4.7982274
433	307	285	313	15732.972	12.812808
433	308	286	313	15478.877	19.269134
433	309	287	313	15251.093	24.54843
433	310	288	313	15239.009	28.636988
433	311	289	313	15236.935	31.953368

tv1	tcond	tc1	tc2	Exergy	Efficiency
435	306	298	306	16145.2	4.7985
436	307	299	307	15732.2	12.8123
436	308	300	308	15478.2	19.2691
437	309	301	309	15251.7	24.54842
437	310	302	310	15239.9	28.63699
438	311	303	311	15236.1	31.95678



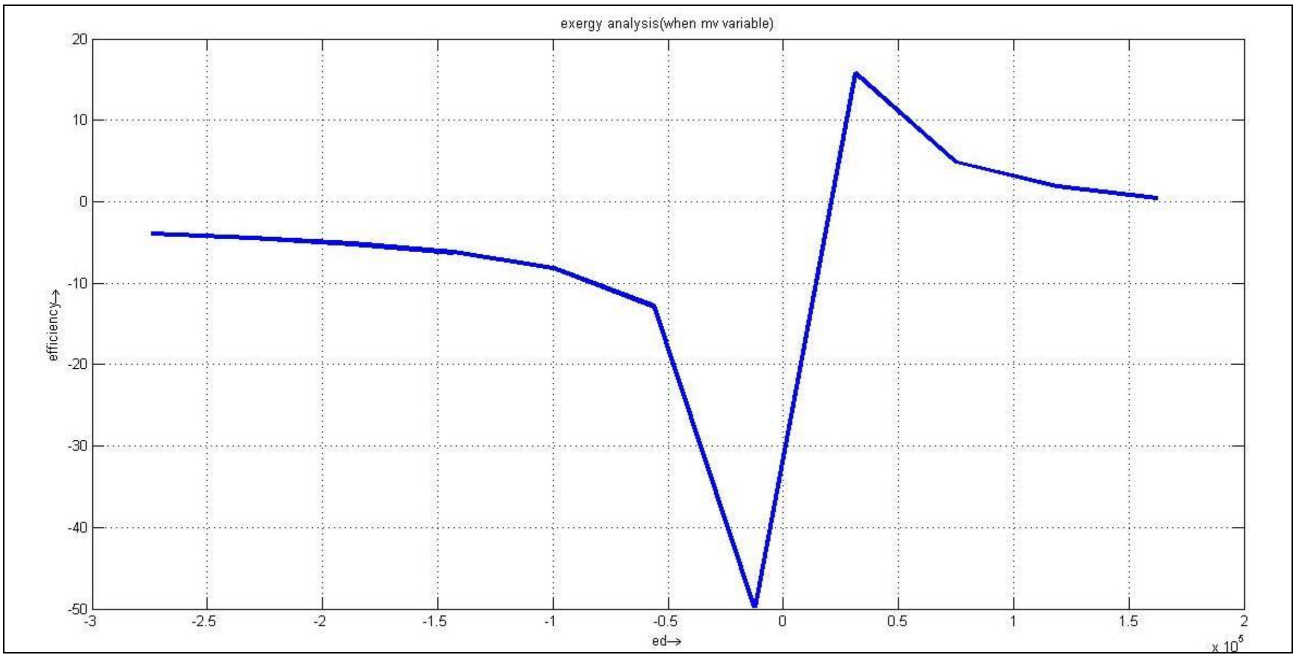


Figure no: *2 Graph*

```
clear all;
close all;
mc=7500;
cpc=4.21;
cpv=2.148;
tcond=318.8;
mv=147;
tc1=284;
tv1=433;
tc2=313:323;
x=length(tc2);
eff=zeros(1,x); to=298;
hfg=2392.98;
sfg=7.5125;
a=to*log(tv1/tcond);
b=tv1-tcond;
c=cpv*(b-a);
e=cpv*((tv1-tcond)-to*log(tv1/tcond));
f=e+hfg-to*sfg;
ed1=mv*f;
for j=1:1:x
i=mc*cpc*((tc2(j)-tc1)-to*log(tc2(j)/tc1));
ed(j)=ed1;
end
plot(tc2,ed);
xlabel('tc2\rightarrow');
ylabel('ed\rightarrow');
title('exergy analysis(when mv variable)');
grid on;
```

Figure no:3, MATLAB PROGRAM

III. CONCLUSION

After Validation This Paper we conclude that there are tcond increase exergy is decrease and efficiency is increase Tcond change 306 to 307 the are ed is 16145.77 to 15732.97 there are efficiency increase to 8% Now tcond 309 to 310 ed is 15251 to 15239 there are efficiency 4.1% Now also tcond 313 to 314 there are ed 15610 to 15941 to increase efficiency 1.2%.

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