An Experimental of Coolant Blends Affects on the Performance of Heat Ex-Changers

Naseema, S. Nawazish Mehdi, M Manzoor Hussain

Abstract--- ***Heat ex-changers have its own area of requirement in energy flow between hot and cold streams. By classify the industrial needs most of the applications in automobiles and power plants needs as small like radiators and as big like boilers and condensers, a part of this chemical and medium level industries also using heat ex-changers in their applications. On focus this area shell and tube ex-changers and compact heat ex-changers are fulfilling the needs of industry requirement. Most of the coolants define the performance levels of the heat ex-changer. Direct usage of pure coolant is very expensive so that industries using water blends with coolants. Researchers are welcoming for efficiency increases with low cost of coolant with good performance an attempt made to check the performance of two types of heat ex-changers blend with market available coolants S4-zx, Castrol and MFC coolants with 8 and 10 % with water.S4-Zx with 10% at a temperature of 600 with complete flow given an efficiency difference3% has observed when compared with others.***

Keywords: Heat exchangers, shell and tube, compact, general coolants, water blends

I. INTRODUCTION

Heat exchangers are one of the most desirable in industrial applications as well as automobiles, much awareness in locomotives shell and tube heat exchangers are widely used. Heat transformation processes usage in power plants also significant development area for heat exchangers. The customised design for the heat exchangers improving day by day leads to design compact heat exchangers along with shell and tube. Most of the heavy plants and industries need development in heat transfer application with good operating conditions without corrosion also an important study.

Studies on high volume heat transfer rate choosing shell and tube heat exchangers with viscous fluids as heat transfer element. Some important considerations in experimental check were pressure drop, less weight and can easily transferable. Vibration, corrosion, radioactivity, and volume also some elements consider for the design of heat exchangers. To cover more surface area heat exchanger design changed regularly by adding fins, circularly and horizontally. The idea of compactness in heat surface area compact heat exchangers developed with the development of different type of fins.

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II. Review of literature

Shell and tube heat exchanger is a category of heat exchanger. Heat exchanger is a gadget used to transfer heat between a great and a fluid or between two or more fluids. Also the fundamental accessories of shell and tube style heat exchanger are shown in drawing and its element dialogue is given. Additionally the constructional details and design methods of shell and tube heat exchangers are given from which kern's process for design is described in element with step inside [1]. There is a broad software of coiled heat exchanger in the field of cryogenics and different industrial applications for its more advantageous warmness switch characteristics and compact constitution. Lots of researches are going on to improve the heat transfer cost of the heat exchanger a fabrication of the shell and tube heat exchanger with picking out the substances on the principal function of improving the heat transfer effectiveness. We casted the tube within the spiral form with the helical perspective of 30˚.Then we supposed to participate in calculation on the warmness transfer Effectiveness. [2] Shell and Tube heat exchangers are having distinctive importance in boilers, oil coolers, condensers, pre-heaters. They're also commonly used in approach applications as well because the refrigeration and air conditioning industry. The robustness and medium weighted form of Shell and Tube heat exchangers make them good suited to high stress operations. [3] The design of STHE entails thermal design and mechanical design. The thermal design of STHE includes analysis of required powerful floor field (i.E. Quantity of tubes) and discovering out log imply temperature change [LMTD]. Whereas, the mechanical design involves the design of primary shell beneath inner & external pressure, tube design, baffles design gasket [4] in many industrial purposes compact warmth exchangers function became essential when you consider that to enhance of heat transfer fee and for better performance. Extra the compact warmth exchangers are being considered for heavy duties to develop more heat transfer with the aid of involving the segment change approaches at boiling and also condensation. In mean at the same time figuring out the thermal-hydraulic characteristics of glide passages for compact heat exchangers the segment trade vitally important [5] Compact

heat Exchanger gadget is which transfer of heat one position to other location with minimal losses. On this paper we calculate numerically heat obtains by CI engine at utilized of special load. In line with that we calculate design of compact kind of heat exchanger and fabricated it [6]

The Performances of compact heat exchangers (CHEs) are together with well-founded devices, some relative novices to the market and likewise designs nonetheless being proven in the laboratory. The buildings of the CHEs are in brief introduced, and their heat switch enhancement mechanisms, as good as their advantages and obstacles, are summarized. Then, exclusive heat switch enhancement technologies in CHEs are compared and their thermo-hydraulic performances are analyzed on the basis of on hand correlations for heat transfer and friction element developed by way of various investigators quoted within the open literature. [7]

III. Objectives

1. To check the comparison of different coolant runs in both shell and tube, compact heat exchanger.
2. To optimise best fluid domain mixed with water known water blends performance.
3. To verify the heat exchange performance in both the cases

IV. Blend preparation and properties:

Continuous blending is ideal for many kinds of beverages, but producers are still looking for opportunities to further reduce product losses and water consumption.

4.1 table shows Parameters of the blends used

Parameter	Castrol		Shell Diala S4 ZX-		MFC Coolant	
	8%	10%	8%	10%	8%	10%
Density (kg/m^3)	1040	1065	1263	1358	2028	2807
Boiling point (^{0}c)	112	123	132	139	135	145
Melting point (^{0}c)	104	104	-20	-20	70	70
Thermal conductivity (W/m^{0}c)	6.628	6.628	3.727	3.726	5.231	5.231
Specific heat (Kj/Kg/K)	0.523	0.523	0.089	0.089	0.689	0.689

Table 4.2 Factors and basic parameters of industrial need for shell and tube heat exchanger

Heat INPUT	65XE^{03} kcal/hr
Water quantity	50m^3/hr predicted
Oil quantity input	14.75m^3/hr
Inlet water temperature input	33°C
Input data for outlet water temperature	34.3°C
Temperature at inlet for oil	45°C
Temperature at outlet for oil	54.45°C
Pressure drop at water side	0.6 kg/cm^2
Pressure drop at oil side	0.6 kg/cm^2
Water side fouling factor	0.0004 hr-m^2-°C/kcal
Oil side fouling factor	0.0002 hr-m^2-°C/kcal
Tube material	Admiralty brass
Thermal conductivity of tube material	66 BTU/hr-ft^2 ^{0}F
Total number of tubes	90
Tube passes	2
Tube length	3300mm=3.300 m
OD of the yube	OD=19.05mm=0.01905m
Thickness of tube	1.650mm=0.00165m
Inside diameter of tube	OD-2×Thickness of tube = 15.75mm =0.01575m
Tube type	Plain type
Tube pitch	25.4mm=0.0254m
Ratio of outside to inside surface area	$A_o/A_i = \pi d_o L/\pi d_i L = 1.2095$
Number of baffles	33

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Baffle cut	22%
Type of heat exchanger	Shell and tube AEW type heat exchanger (floating rear tube sheet)
Baffle thickness	6mm=0.006m
Shell inside diameter	307mm=0.307m
Shell outside diameter	323.8mm=0.3238m
Shell thickness	8.4mm=0.0084m
Baffle spacing	86mm=0.086m

Table 4.3 Factors and basic parameters of industrial need for compact heat exchanger

FLUID DATA AND PROPERTIES		HOT SIDE		COLD SIDE	
Fluid Designation and Allocation		PROCESS WATER		CHILLED WATER	
		Channel 1		Channel 2	
		Entering	Leaving	Entering	Leaving
Temperature	*Oc*	120	test	0	Test
Operating Pressure	*Bar*	8		5	
Fluid Flow rate, Total	*Kg/h*				
Density	*Kg/m3*	99	95	94	97
Specific Heat	*Kj/(kg C)*	.18	.18	.18	.18
Dynamic Viscosity	*CP*	1	1	1	1
Thermal Conductivity	*W/(m.K)*	.002	.002	.002	.002
Fouling	*M2.K/W*				
PERFORMANCE DATA					
Pressure Drop	Bar	0.5		0.5	
LMTD	C	15.05			
Heat Transferred	W	70			
HT Area Required – Cleaned Surface	2	1.05			
HT Area Required – Fouled Surface	2	1.09			
HT Area Provided	m2	1.2			

V. Experimental procedures:

Figure 4.1Experimental setup of shell and tube heat exchanger

Figure 4.2 Experimental setup of compact heat exchanger

T1= heat inlet
T2=heat outlet
T3=cold inlet
T4=cold outlet

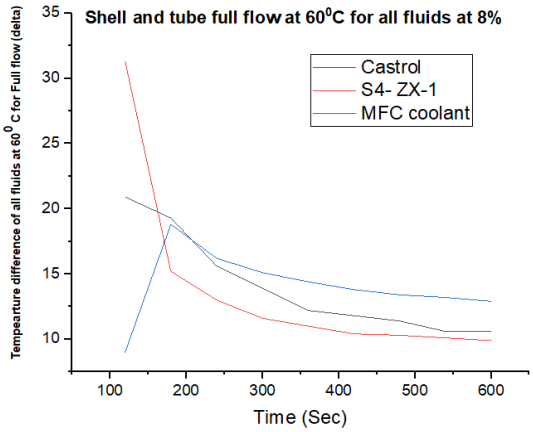
In this we are going to take initial Hot pressure P1 and cold pressure P2. The flow is done in two ways for each temperature that is complete floe and half sectional flow.

We are taking flow initially as X1 and final X2 is final flow reading after completing the process

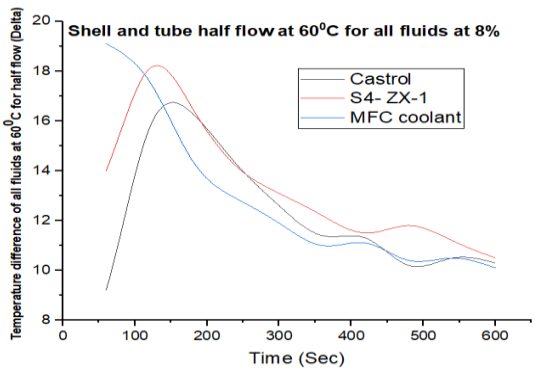
VI. Results and Discussions:

Here optimization is done for 8% and 10% of Castrol, Shell Diala S4 ZX-1 and MFC coolant blends for at different temperatures 60^0c and 80^0c. Initially the hot tank containing the water is gradually heated to 60^0c. Then the process is started T1, T2, T3 and T4.

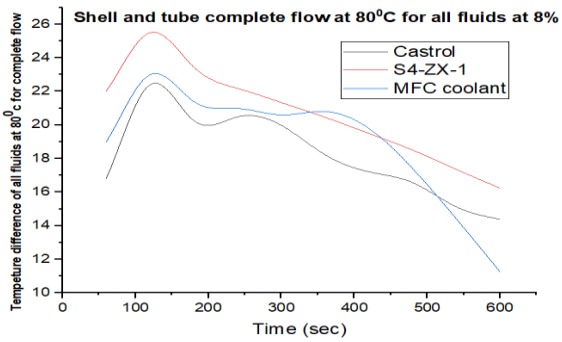
Temperature difference observations for shell and tube heat exchanger:



The above figure 5.1 shows the temperature difference of all the blends at 60^0C for 8% blend with complete flow in shell in tube heat exchanger.



The above figure5.2 shows the temperature difference of all the blends at 60^0C for 8% blend with half flow in shell in tube heat exchanger.



The above figure5.3 shows the temperature difference of all the blends at 80^0C for 8% blend with half flow in shell in tube heat exchanger.

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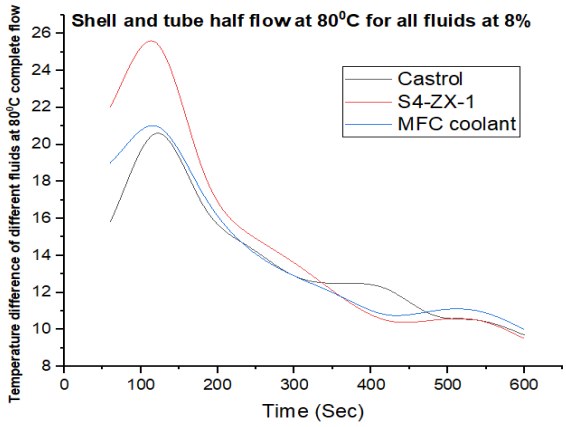
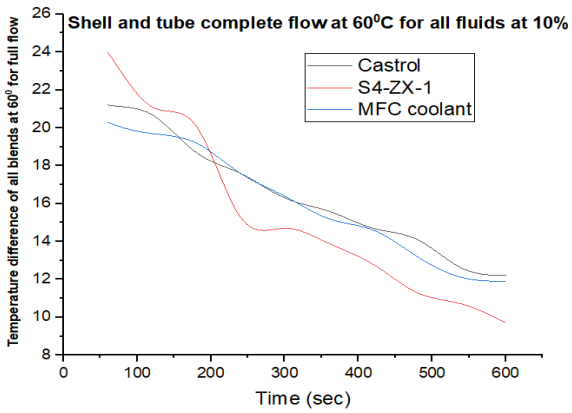
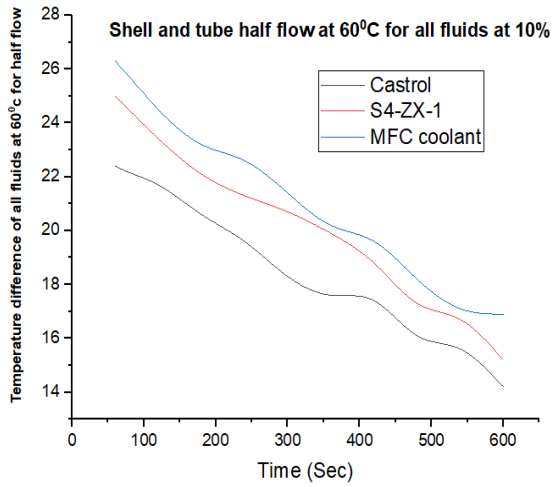


The above figure5.4 shows the temperature difference of all the blends at 80^{0}C for 8% blend with half flow in shell in tube heat exchanger.

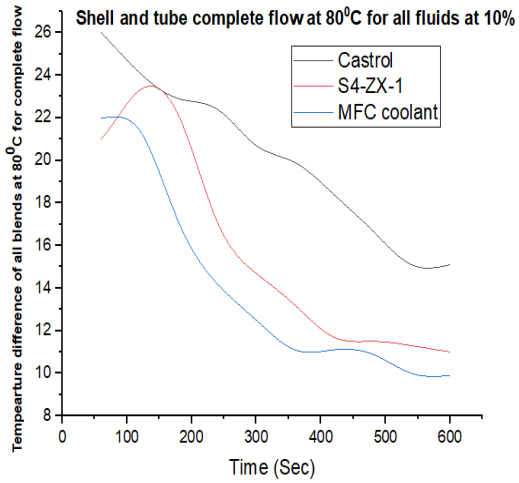


The above figure5.5 shows the temperature difference of all the blends at 60^{0}C for 10% blend with complete flow in shell in tube heat exchanger.

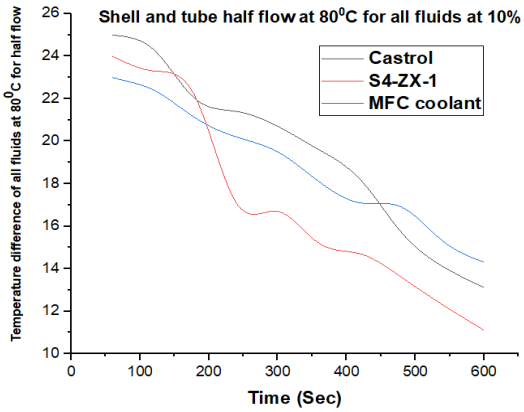


The above figure shows the temperature difference of all the blends at 60^{0}C for 10% blend with half flow in shell in tube heat exchanger.

The above figure shows the temperature difference of all the blends at 60^{0}C for 10% blend with half flow in shell in tube heat exchanger.

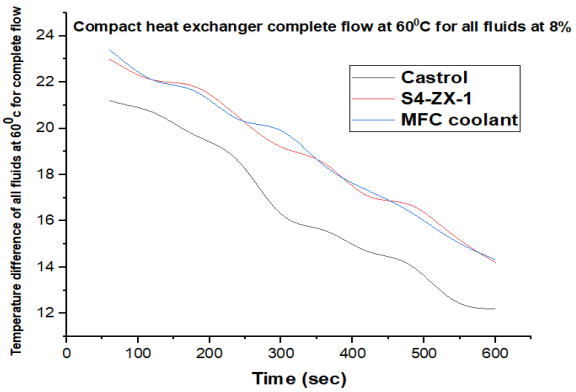


The above figure 5.6 shows the temperature difference of all the blends at 80^{0}C for 10% blend with complete flow in shell in tube heat exchanger.



The above figure 5.7 shows the temperature difference of all the blends at 80^{0}C for 10% blend with half flow in shell in tube heat exchanger.

Temperature difference observations for Compact heat exchanger:



The above figure shows the temperature difference of all the blends at 60^{0}C for 8% blend with complete flow in compact heat exchanger.

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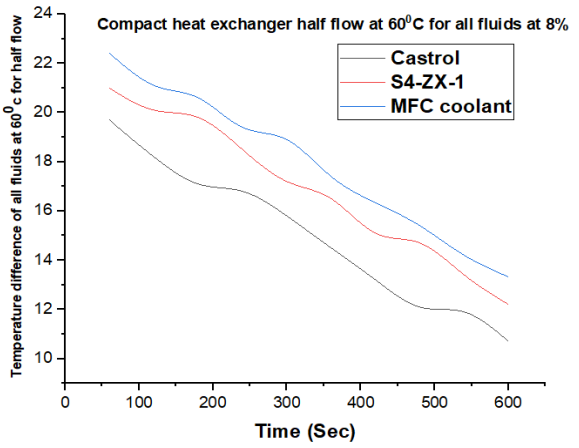
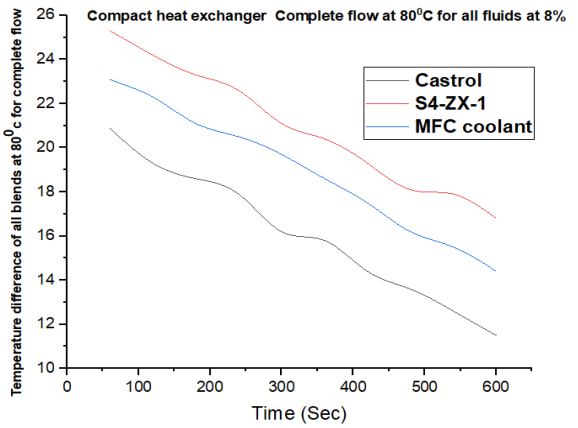
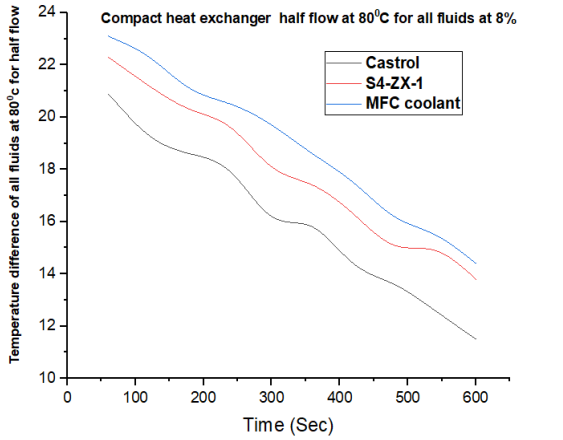


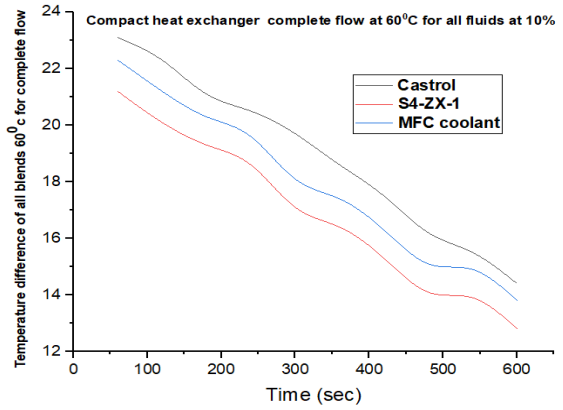
The above figure 5.8 shows the temperature difference of all the blends at 60^0C for 8% blend with half flow in compact heat exchanger



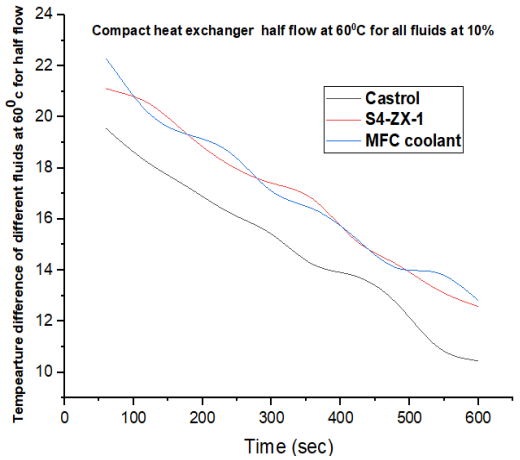
The above figure 5.9 shows the temperature difference of all the blends at 80^0C for 8% blend with complete flow in compact heat exchanger



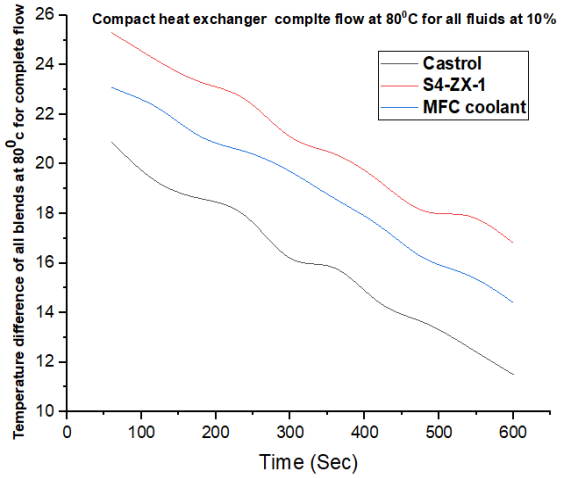
The above figure 5.10 shows the temperature difference of all the blends at 80^0C for 8% blend with half flow in compact heat exchanger



The above figure 5.11 shows the temperature difference of all the blends at 60^0C for 10% blend with complete flow in compact heat exchanger



The above figure 5.12 shows the temperature difference of all the blends at 60^0C for 10% blend with half flow in compact heat exchanger



The above figure 5.13 shows the temperature difference of all the blends at 80^0C for 10% blend with complete flow in compact heat exchanger

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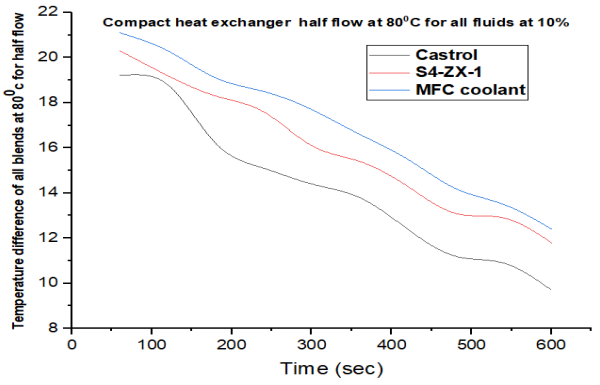

The above figure 5.14 shows the temperature difference of all the blends at 80^0C for 10% blend with half flow in compact heat exchanger

Here from the above data enhanced it is observed that MFC coolant is giving better temperature in both the cases of Shell and tube and compact heat exchangers. So the performance allocution with MFC coolant is enhanced.

Experimentally observed data for performance calculation:

T1 = 42.63, T2 = 73.62, T3 = 82.65, T4 =62.36, P1 = 1.1 bar, P2 = 9 bar, Flow rate=1000litr/min

Mass flow rate = Volume flow rate $\times p4/RT4$

=0.02kg/s

Heat capacity of hot and cold fluids,

Cc = mc×Cpc = 0.010087 KW/K

For hot fluid, Ch = mh×Cph = 0.010093 KW/K

Capacity Rate ratio, Cr = Cmin/Cmax = 0.9994

Effectiveness, $\varepsilon_h = \frac{Ch(Thinlet-Thexit)}{cmin(Thinlet-Thexit)}$ =95.26

$\varepsilon_c = \frac{Cc(Thinlet-Thexit)}{Ccmin(Thinlet-Thexit)}$ = 88.32

Number of transfer units, NTU = 16.009

Overall Heat transfer conductance, UA_0

UA_0 = NTU×Cmin

= 16.009×0.010087

=161.4827 W/K

VII. Conclusions:

Here an experimental approach is conducted for 3 different fluids Castrol, S4-ZX-1, MFC coolant for two different temperatures 60^0c and 80^0c with two different flow conditions Complete and half flow with two different blend percentages of 8 % and 10% for both shell and tube and compact heat exchangers. Here by conducting these experimental approaches we found that the compact heat exchanger is giving better performance than shell and tube for the testing conditions and fluid flow rate conditions by which we can state that in evaluation of performance and efficiency compact heat exchanger will better suggested. We have also observed that MFC coolant gives better flow rate conditions in both conditions of shell and tube and compact heat exchanger.

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