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Research Article

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To Study the Effect of Various Fluid Systems on Rate of Heat Transfer For Shell and Tube Heat Exchanger

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ABSTRACT

The shell and tube type of heat exchanger module is to be design for lab study of effect of various parameters on rate of heat transfer. The ionic fluid is used to see the difference in outlet temperature of fluid as compared to reference fluid. The cooling fluid is made by adding various amounts of solutes to water and the effect is observed on rate. Also suggestions are made on the nature of heat transfer, rate of heat transfer and improved effectiveness in the rate of heat transfer as compared to the normal process. The conclusions are made about the fluid used , and effect of solute on rate of heat transfer.

Index Terms— ***Effectiveness, Heat Exchanger, Ionic fluid.***

I. Introduction

Shell and tube heat exchanger are one of the most widely used type of heat exchanger in the process industries (65%of the market) and are commonly found in oil refineries, nuclear power plants and other large scale chemical processes[5]. Additionally, they can be found in many engines and are used to cool hydraulic fluid and oil. In this application, two separated fluids at different temperatures flow through the heat exchangers: one through the tubes (tube side) and other though the shell around the tubes (shell side). Several design parameters and operating conditions influence the optimal performance of shell and tube heat exchangers.

II. Procedure

The "fig." describes the flow of fluid and equipment arrangement for the research. The heat exchanger and equipments are assembled systematically. The fluid solutions are made with various solutes. The solutes such as NaCl, KOH, 1-Butyl-3-methylimidazolium chloride, etc are used for the experiment. The solutions of various normalities are made and temperatures of inlet and outlet are measured to determine the effect on rate of heat transfer

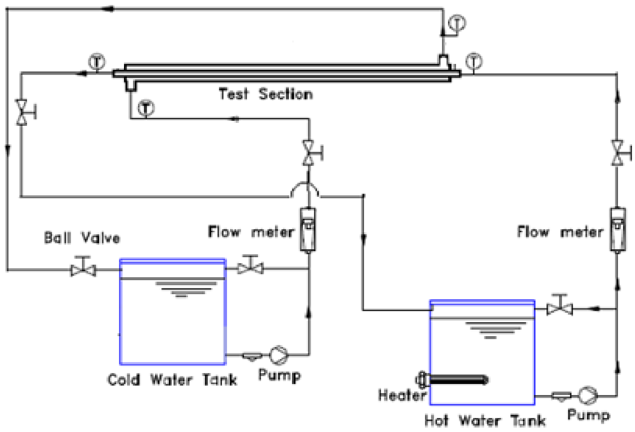

Figure: schematic diagrams of apparatus

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III. Design of Equipment

A shell and tube heat exchanger of dimension length-39 cm, shell diameter 9 cm, Tube diameter 0.62 cm is used. Stainless steel is used as the material of construction.

IV. Result Discussion

The graphs are plotted between LMTD and concentration of fluids shows that the LMTD increases with the increase of concentration for constant flow rate

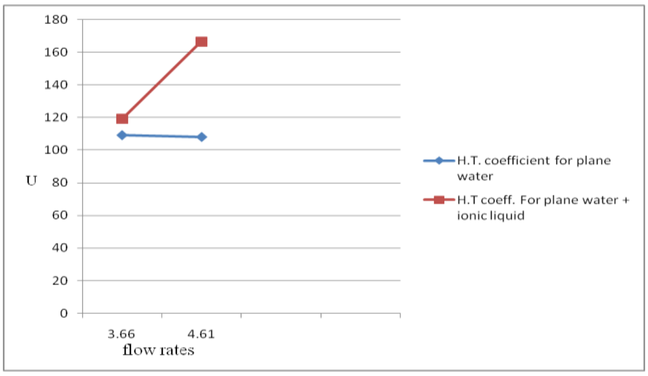

Figure: Graph for Ionic Fluid

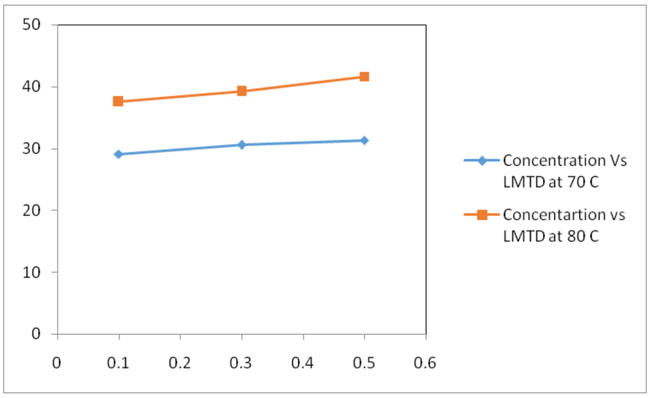

Figure: Graph for KOH

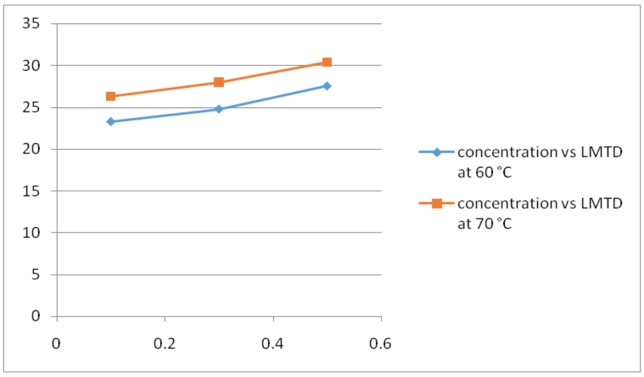

Figure: Graph for NaCl

V. Experimental data

For Ionic Fluid

Sr. no	Flow rates of hot & cold stream(lit/min)	H.T. coefficient For plane water	H.T. coefficient For plane water + 1gm ionic fluid
1	3.66	109.25	119.145
2	4.61	108.16	166.78
3	6.66	118.16	

For KOH

Serial No.	Conc. Of solution (N)	T_{h1},°C	T_{h2},°C	T_{c1},°C	T_{c2},°C	H LPH	C LPH	LMTD Θ_m ,°C
1	0.1	70	43	20	28	40	40	29.07
1	0.1	80	52	21	30	40	40	37.50
2	0.3	70	47	20	30	40	40	30.58
2	0.3	80	58	22	33	40	40	39.21
3	0.5	70	50	20	32	40	40	31.32
3	0.5	80	63	21	35	40	40	41.59

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For Reference fluid (Water)

SR No.	Hot in (T_{h1}°C)	Hot out (T_{h2}°C)	Cold in (T_{c1}°C)	Cold out (T_{c2}°C)	Flow rate (hot) (LPH)	Flow rate (cold) (LPH)	LMTD (°C)
1	60	51	25	30	50	50	27.406

For NaCl

Sr. No.	Conc. (Normality)	Hot inlet water temp. $T_{h1,}$ °C	Hot outlet water temp. $T_{h1,}$ °C	Cold inlet solution temp. $T_{c1,}$ °C	Cold outlet solution temp. $T_{c2,}$ °C	Flow rate of hot water LPH	Flow rate of solution LPH	LMTD °C
1	0.1	60	37	20	25	20	40	23.25
1	0.1	70	45	21	33	30	40	26.29
2	0.3	60	41	20	27	20	40	24.76
2	0.3	70	50	21	36	30	40	27.97
3	0.5	60	46	20	30	20	40	27.55
3	0.5	70	58	21	40	30	40	30.34

VI. Conclusion

The ionic fluid (1-butyl 3-methyl imidazolium chloride) is not a very promising alternative fluid as compared to NaCL and KOH to increase the heat transfer rate especially for shell & tube heat exchanger. Among the fluids chosen KOH shows satisfactory results

VII. Abbreviations

1. LMTD: Logarithmic temperature difference
2. LPH: Liquid Flow rate
3. C: Cold Fluid
4. H:Hot fluid
5. 1,2:Inlet and outlet

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