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HEAT TRANSFER ENHANCEMENT OF PARALLEL FLOW AND COUNTER FLOW HEAT EXCHANGER USING DIFFERENT INSERT

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ABSTRACT - *A Heat transfer enhancement of parallel flow and counter flow heat exchanger with different inserts are investigated experimentally in this study. The different inserts of normal, W-Cut, Right angle triangle with the same perimeter are examined to determine their relationships to the overall heat transfer coefficient and Heat transfer rate. The heat exchanger performance are also tested In the experiment, hot water (at a temperature of 60°C) with a constant flow rate of 2.8 kg/s flows through the heat exchanger. The results indicate that the modified heat exchanger with different inserts, w-cut twisted tap inserts having more overall heat transfer coefficient, Heat transfer rate due to high VG'S .*

Key words: heat transfer enhancement, parallel flow and counter flow heat exchanger, twisted tape

1. INTRODUCTION

Heat exchangers are used in various industrial applications and are devices that are installed to permit the transfer of thermal energy between two (or more) fluids at different temperatures without having direct contact. Parallel-flow, counter-flow and cross-flow heat exchangers are in operation and their overall performance. Heat transfer increases have been studied experimentally and theoretically and first results are reported in the present paper. For heat transfer enhancements in heat exchangers, there are two methods available are active and passive methods. For active methods, some external power is needed to achieve the attempted heat transfer enhancement, usually formal flowing fluid to a heat exchanger wall. It may be noted that in a counter-flow arrangement of a heat exchanger, the outlets of fluids transmitted opposite ends and this enables the outlet temperature of cold fluid to rise above the outlet temperature of the warm fluid. This is not possible in a parallel flow arrangement, and hence as far as the heat transfer rate is concerned, the counter-flow heat exchangers are superior to the parallel type [8]. Nevertheless, it is not possible to use a counter-flow heat exchanger in all practical situations. Therefore, a common arrangement in practice is a heat exchanger with a cross-flow arrangement and this is characterized by a better temperature distribution compared with the parallel-flow heat exchanger, but the temperature distribution in such a heat exchanger is not as good as in the case of a counter-flow arrangement. Both effective surface enhancement elements and the optimal flow arrangement were employed during the experimental investigation both parallel and counter flow heat exchanger described in the present work.

2. METHODOLOGY

In this work we are fabricated parallel flow and counter flow heat exchange the dimensions of the inner pipe are: diameter of 22 mm, thickness 1 mm. the dimensions of outer pipe: diameter=46 mm. Length of the pipe is 450 mm. The four different type of twisted tap inserts are designed for length of 450 mm are normal twisted tap, W-Cut twisted tap, and Right angle triangle cut twisted tap at a thickness of 20 mm.

TYPE 1: Normal twisted tape

TYPE 2: W-cut twisted tape

TYPE 3: Triangular type twisted tape

TYPE 4: Right angle triangular twisted tape

Fig:1 Experimental setup:

The twisted tap is inserted inside the inside tube of thickness 20 mm and reading are taken for the arrangements of both parallel and counter flow with the

flow rate of hot water is 2.8 kg/s and hot water temperature fixed at 60^{0}C.

3. EXPERIMENTAL READINGS

S.No	Types of fins	Cold water inlet (t1)^{0}C	Cold water outlet (t2)^{0}C	Hot water inlet (T1)^{0}C	Hot water outlet (T2)^{0}C
1	TYPE 1	25	33	60	52
2	TYPE 2	25	31	60	49
3	TYPE 3	25	29	60	46
4	TYPE 4	25	27	60	44

Table.1.Experimental Readings For Parallel Flow

Fig.2. Right angle triangle twisted tap arrangements in the twisted tap with twisting ratio of 1:2

S.No	Types Of Fins	Cold Water Inlet Temperature (t1)^{0}C	Cold Water outlet Temperature (t2)^{0}C	Hot Water Inlet Temperature (T1)^{0}C	Hot Water Outlet Temperature (T2)^{0}C
1	TYPE 1	25	34	60	48
2	TYPE 2	25	32	60	45
3	TYPE 3	25	30	60	44
4	TYPE 4	25	31	60	40

Table.2. Experimental reading counter flow

Figure.3.W-Cut Twisted Tape arrangements in the twisted tap with twisting ratio of 1:2

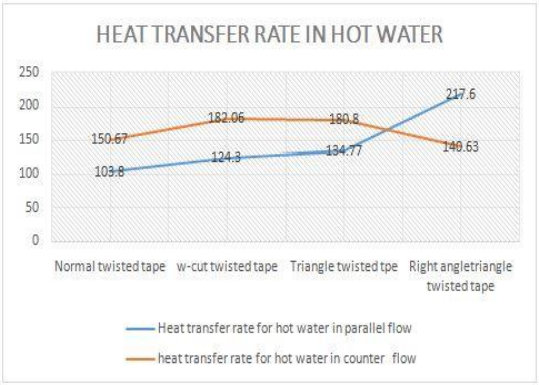
Types of fin	(Q) Hot water kJ	Q cold water kJ	U hot water W/M^2 K	U cold water W/M^2 K	LMTD ^{0}C
TYPE 1	103.80	110.49	103.8	22.96	24.55
TYPE 2	124.30	72.83	38.24	22.46	16.54
TYPE 3	134.77	43.53	27.58	8.91	24.92
TYPE 4	140.63	18.42	29.76	3.77	24.97

Table.3. Experimental Calculations for parallel flow

Types of fin	(Q_H) kJ	Q_C kJ	U_H W/M^{2}K	U_C W/M^{2}K	LMTD ^{0}C
TYPE 1	150.67	128.07	31.28	26.71	24.55
TYPE 2	182.06	90.82	39.19	19.55	16.54
TYPE 3	180.8	54.41	38.30	11.53	24.92
TYPE 4	140.63	62.29	52.29	14.97	24.97

Table.4. Experimental Calculations for Counter flow

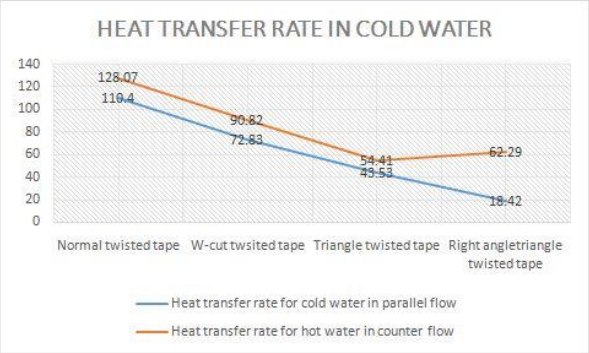
4. RESULT AND DISCUSSION:



Graph.1.Heat transfer rate of hot water in parallel flow Vs Counter flow

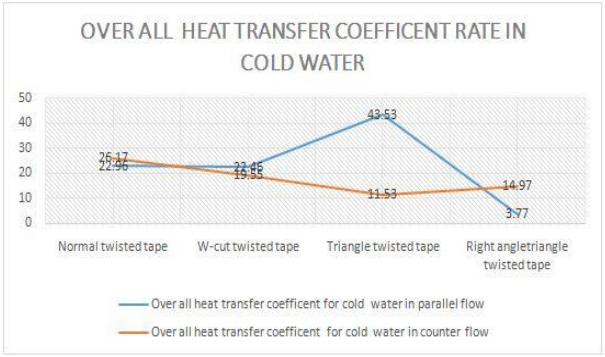
In a graph 1 shows the heat transfer rate in hot water between different inserts for both parallel counter flow arrangements. The parallel flow arrangements comparing of normal twisted tape the heat transfer rate of hot water increases from 150.67 to 217.6 respectively

.W-cut twisted tap and triangle twisted tap and right angle triangle twisted tap shows the more amount of the heat released comparing to other due to higher vortex generation. And also the counter flow arrangements W-cut, triangle, cut giving more heat transfer rate of hot water.



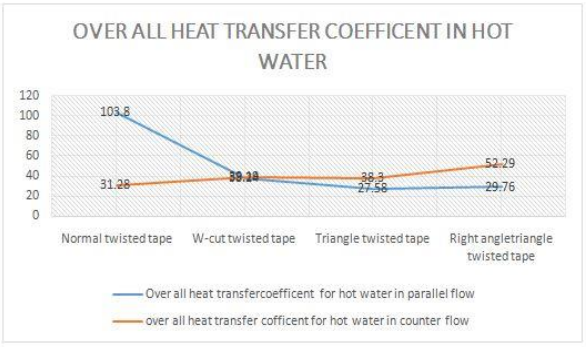
Graph.2.Heat transfer rate of hot water in parallel flow Vs Counter flow

in graph 2 the heat transfer of cold water m parallel flow arrangements vortex. Decreasing from 110.42 to 18.42. The counter flow arrangements decreasing from 54.41 of triangle twisted tap and right angle triangle heat transfer rate is increases due to vortex.



Graph.3.Overall heat transfer coefficient of cold water parallel flow VS Counter flow

In graph 3, over all heat transfer co-efficient of cold water is higher range of 45.53 with triangle twisted tap and counter flow right angle triangle having medium of heat transfer co-efficient rate.



Graph.4.Overall heat transfer coefficient of Hot water parallel flow VS Counter flow

In graph 4 for overall co-efficient of hot water in a counter flow arrangements with right angle triangle twisted tap having the better performance comparing to others.

5. CONCLUSION

Heat transfer enhancement of parallel flow and counter flow heat exchanger the w-cut, triangle and right angle triangle has been investigated in the present work. Regarding to the experimental results, it can be concluded as follows. Heat exchangers with right angle triangle twisted tape having better heat transfer rate of 217.6kj/kg,heat transfer coefficient rate is 52.29 w/m^{2}k comparing to others inserts. Therefore the amount of heat transfer rate increased is 113.8kj/kg and efficiency increased around 20% comparing to normal twisted tape.

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