International Journal of Research
Available at
https://edupediapublications.org/journals

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 06
May 2017

Heat Transfer Enhancement Using Triangular Fin in Heat Exchanger with Nano Fluids

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ABSTRACT

Heat exchanger are useful in many engineering processes like those in refrigeration and air conditioning system, food Processing systems, power systems, chemical reactors and space applications. Many types of heat exchangers are used in industry, such as shell and tube and double pipe, compact heat exchanger, which vary in both application and designs. The present paper we are using the triangular fin copper as material along with the nano fluids like AL203 mixed with based fluid water. Fins are installed on the outer surface of hot water tube. Experiment is conducted in parallel and counter flow. By this heat transfe rate is estimated in each flow.

Key Words: Al203, Triangular Fin,Heat Transfer,Nano Fluid .

INTRODUCTION

The heat exchangers are found to have an extensive variety of uses going from the house-hold purposes to refineries and cryogenic operations. These heat exchangers had turned into the basic prerequisite of the present society as they don't make any destructive impacts the conditions. The cost engaged with this vitality extraction is additionally less and temperate. One of the worries in regards to these heat exchangers is to upgrade the heat transfer and enhance their productivity. The review and looks into had been completed in an expansive way to enhance the heat transfer improvements. In this unique circumstance, a goal is set to survey the writing identified with heat exchangers under the accompanying classifications: general investigation of heat exchangers, different arrangements of heat exchangers, the minimal heat exchangers and the impacts of nanofluid in the heat transfer upgrades. A few logical clarifications have been done on the field of heat. A few laws of material science have been demonstrated and acknowledged for customary use when all is said in done application purposes. Such laws of material science propose that heat can move from a body with higher temperatures into a body with bring down temperatures. It consequently implies that for heat transfer to occur there must be temperature distinction between the two bodies.

In any case, heat transfer from one body to alternate happens through different strategies. Such strategies incorporate radiation, conduction and convection. Contingent upon the idea of issue included, a particular technique for heat transfer is

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 06
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constantly included. Radiation regularly includes vitality transfer in type of electromagnetic radiations. The transfer of heat from sun to the earth is through the procedure of radiation.

PREPARATION OF NANO FLUID:

The planning of nano liquid is the principal imperative stride in utilizing nano stage particles to change the heat transfer rate of ordinary liquids. Nano liquids are basically comprised of metals, oxides, carbides and carbon nano tubes that can without much of a stretch be apportioned in heat transferring liquids, for example, water, ethylene glycol, hydrocarbons and fluorocarbons by expansion of balancing out operators. Nano particles can likewise be delivered from a few procedures to be specific gas buildup, mechanical attribution or substance precipitation. These nano particles can likewise be created under cleaner conditions and their surface can be shielded from surprising coatings which may happen amid the gas buildup process. The principle confinement of such strategy is that the all particles made by this technique happen with some inadequacy to create immaculate metallic nano powders. The development of such an issue can be diminished by utilizing an immediate dissipation buildup technique [2, 3, and 4]. This technique helps in controlling molecule size and creates particles for stable nano liquids without surfactants or any electrostatic stabilizers, yet has the weakness of oxidation of immaculate metals and low vapor weight liquids. There are essentially four stages during the time spent the immediate vanishing - buildup strategy otherwise called one stage technique.

1. A barrel containing a heat transferring liquid, for example, water or ethylene glycol is turned inside with the goal that a thin film of the liquid is always launched out through the highest point of the chamber.
2. A bit of metallic material is vanished by heating on a cauldron as the wellspring of the nano particles.
3. The liquid is permitted to cool at the base of the chamber to keep any kind of undesirable vanishing. Another strategy for blend of nano liquid is the laser removal technique, which is utilized to deliver alumina nano liquids [5].
4. Immaculate substance combination is additionally an option strategy which has been utilized by Patel [6] to get ready gold and silver nanofluids. Zhu et al [7] additionally utilized one-stage immaculate concoction union strategy for get ready nanofluids utilizing copper nano particles apportioned in ethylene glycol. There are essentially four courses for the union of nano liquids or critical variables. They are essentially, 1. Apportioning capacity of nano particles 2. Security factor of nano particles 3. Compound similarity related to nano particles 4. Warm steadiness of nano liquids.

Basic Heat Exchanger Flow Arrangements:

Two fundamental stream game plans are as appeared in Figure Parallel and counter stream. In parallel stream both the hot and icy streams enter the heat exchanger at a similar end and go to the inverse end in parallel streams. Vitality is transferred along the length from the hot to the cool liquid so the outlet temperatures asymptotically approach each other. In a counter stream game plan, the two streams enter at inverse closures of the heat exchanger and stream in parallel yet inverse bearings. Parallel stream brings about quick beginning rates of heat

p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 06
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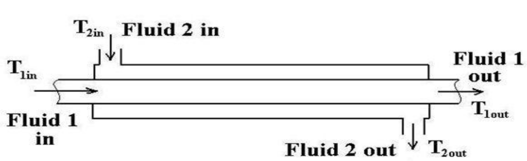
trade close to the passage, however heat transfer rates quickly diminish as the temperatures of the two streams approach each other this prompts higher vitality misfortune amid heat trade. Counter stream accommodates moderately uniform temperature contrasts and, subsequently, lead toward generally uniform heat rates all through the length of the unit.

Parallel Flow:

A double pipe heat exchanger can be worked in parallel stream mode as appeared in the graph parallel stream by having the two liquids enter toward one side and exit at the flip side. With parallel stream the temperature contrast between the two liquids is huge at the passageway end, however it turns out to be little at the leave end as the two liquid temperatures approach each other. The general measure of heat transfer main impetus, the log mean temperature contrast is more prominent for counter stream, so the heat exchanger surface zone prerequisite will be bigger than for a counter stream heat exchanger with a similar delta and outlet temperatures for the hot and the frosty liquid.

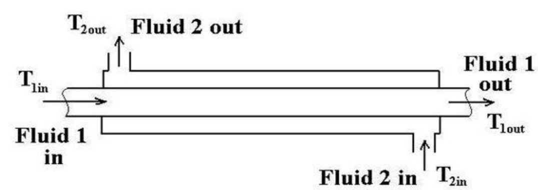


Double Pipe Heat Exchanger
Parallel Flow

fig no :(1)

Counter flow:

A counter flow heat exchangehas the hot liquid entering toward one side of the heat exchanger stream way and the chilly liquid entering at the flip side of the stream way. Counter stream is the most widely recognized kind of fluid heat exchanger, since it is the most productive. A double pipe heat exchanger is typically worked as a counter stream heat exchanger, as appeared in the graph.



Double Pipe Heat Exchanger
Counterflow

Fig no: (2)

SYSTEM OVERVIEW AND WORKING

The experimental setup consists of two concentric tubes in which fluids pass. The hot fluid is hot water, which is obtained from an electric geyser. Hot water flows through the inner tube, in one direction. Cold fluid is cold water, which flows through the annulus. Control valves are provided so that direction of cold water can be kept parallel or opposite to that of hot water. Thus, the heat exchanger can be operated either as paralle1 or counter flow heat exchanger. The temperatures are measured with thermometer. Thus, the heat transfer rate, heat transfer coefficient, LMTD and effectiveness of heat exchanger can be calculated for both parallel and counter flow.

Specifications:

(1) Heat exchanger - (a) Inner tube - 12 mm OD and11 mm ID copper tube.
(b) Outer tube - 25 mm G. I. Pipe
(c) Length of Heat exchanger is 1 m
(2) Electric heater - 3 KW Capacity to supply hot water.
(3) Valves for flow and direction control- 5 No's.
(4) Thermometers to measure temperatures - 10 to 110°C - 4 No's.
(5) Measuring flask and stop clock for flow measurement.

Fabrication of heat exchanger involves different machining processes which are based on factors such Machining properties such turning, drilling, boring.

WORKING PROCEDURE:

1. The power supply is switched on the electric geyser ensuring that there is adequate water flow though geyser.
2. Check the valves are in proper condition for required flow mode.
3. Start the water supply.
4. Adjust the water supply on hot and cold sides.
5. Keep the valves V2 & V3 closed and V1 & V4 opened so that arrangement is parallel flow.
6. Switch ON the geyser. Temperature of water will start rising. After temperatures
become steady, note down the readings in the observation table.

Repeat the experiment by changing the flow. Now open the valves V2 & V3 and then close the valves V1 & V4. The arrangement is now counter flow. Wait until
the steady state is reached and note down the readings

CALUCULATIONS

TRIANGULAR FIN HEAT EXCHANGER WITH OUT NANO FLUID

PARALLELFLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
57	30	36	35
56	30	37	36
57	30	37	36

Effectiveness (ε): = $\frac{Tco-Tci}{Thi-Tci}$ = 0.25

TRIANGULAR FIN HEAT EXCHANGER WITH OUT NANO FLUID
COUNTER FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Cold water outlet temperature (T_3) °c
56	31	44	46
52	33	44	47
55	33	46	39

Effectiveness (ε) : = $\frac{Tco-Tci}{Thi-Tci}$ = 0.59

TRIANGULAR FIN HEAT EXCHANGER WITH NANO FLUID :
PARALLEL FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
56	36	42	43
52	35	42	46
55	37	45	49
52	36	45	49

Effectiveness (ε) = $\frac{Tco-Tci}{Thi-Tci}$ = 0.562

TRIANGULAR FIN HEAT EXCHANGER WITH NANO FLUID
COUNTER FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
55	37	48	48
57	36	50	47
60	35	54	45
63	40	60	45

Effectiveness (ε) = $\frac{Tco-Tci}{Thi-Tci}$ = 0.76

HEAT EXCHANGER WITH OUT TRIANGULAR FIN WITH OUT NANO FLUID :
PARALLEL FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
40	26	28	35
45	35	30	38
48	30	34	42
50	31	34	42

Effectiveness (ε) = $\frac{Tco-Tci}{Thi-Tci}$ = 0.157

HEAT EXCHANGER WITH OUT TRIANGULAR FIN WITH OUT NANO FLUID :
COUNTER FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
35	34	37	30
40	35	38	39
49	36	39	45
53	37	40	50

Effectiveness (ε) = $\frac{Tco-Tci}{Thi-Tci}$ = 0.1875

HEAT EXCHANGER WITH OUT NANO AND WITH NANO FLUID :
PARALLEL FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
57	35	40	48
53	37	40	50
52	36	42	50

Effectiveness (ε) = $\frac{Tco-Tci}{Thi-Tci}$ = 0.227

HEAT EXCHANGER WITH OUT TRIANGULAR FIN AND WITH NANO FLUID :
COUNTER FLOW:

Hot water inlet temperature (T_1) °c	Cold water inlet temperature (T_2) °c	Cold water outlet temperature (T_3) °c	Hot water outlet temperature (T_4) °c
54	30	35	43
55	33	38	43
56	36	40	45

Effectiveness (ε) = $\frac{Tco-Tci}{Thi-Tci}$ = 0.287

RESULTS AND DISCUSSIONS

From the above study it clearly known that the mesh type heat exchanger along with al2o3 nano fluid has a vast increase in its effectiveness in counter flow when compared to the all other.

The following results are obtained Effectiveness of triangular fin type heat exchanger with nano fluid (counter flow) = 0.76

CONCLUSION

In this paper, exploratory investigation of work sort heat exchanger alongside AL2O3 Nanofluid is directed to contrast and purge heat exchanger and furthermore to compute heat transfer rate of chilly water and high temp water, LMTD, general heat transfer rate and viability. Heat transfer rate is more in the event of counter flow work sort heat exchanger with nano fluid

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