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Heat Transfer Enhancement Using Mesh in Heat Exchanger with Nano Fluids

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ABSTRACT
There is a requirement for expanding of thermal systems to improve the heat transfer rates. In the test setup the strong nano particles of al_2o_3 are brought into the base liquid that is water and fine work is embedded into the inward container of double pipe heat exchanger. The volume of 0.1% of nano liquid is explored for various flow rates of plane tube and along with the fine mesh. The outcome shows an immense change in the effectiveness of the heat exchanger.

Key words: Heat exchanger, al_2o_3, effectiveness, fine mesh, nanofluid.

INTRODUCTION
The heat exchangers are found to have an extensive variety of utilizations extending from the house-hold purposes to refineries and cryogenic operations. These heat exchangers had turned into the fundamental prerequisite of the present society as they don't make any destructive impacts the situations. The cost associated with this vitality extraction is additionally less and sparing. One of the worries in regards to these heat exchangers is to upgrade the heat transfer and enhance their effectiveness. The review and explores had been done in a substantial way to enhance the heat transfer upgrades. In this specific situation, a goal is set to audit the writing identified with heat exchangers under the accompanying classifications: general investigation of heat exchangers, different designs of heat exchangers, the conservative heat exchangers and the impacts of nanofluid in the heat transfer improvements. 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 hence implies that for heat transfer to occur there must be temperature contrast between the two bodies. Be that as it may, heat transfer from one body to alternate happens through different techniques. Such techniques incorporate radiation, conduction and convection. Contingent upon the idea of issue included, a particular strategy for heat transfer is constantly included. Radiation ordinarily includes vitality transfer in type of electromagnetic radiations. The transfer of heat from sun to the earth is through the procedure of radiation.

ROLE OF NANO FLUID IN HEAT TRANSFER ENHANCEMENT
Abed et al. (2014) examined numerically the upgrade of heat transfer in the channel V-formed wavy lower plate utilizing fluid nanofluids. The scope of Reynolds number contemplated is around 8000 – 20000(Re). The impacts of various sorts of nanoparticles (Al2O3, CuO, SiO2 and ZnO) alongside the examination liquid are considered. Besides, the impacts of various volume divisions (go 0-4%) of these nanoparticles are examined. It is discovered that the heat transfer was upgraded with the expansion of the convergences of the nanoparticles in the base liquids. The SiO2-glycerin has the most astounding estimation

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of Nusselt number. The glycerin based nanofluids have more noteworthy heat transfer upgrades [15]. Ali Najah Al-Shamani et al. (2014) directed an examination in regards to the heat transfer because of turbulent flow of nanofluids (base liquid with nanoparticles Al2O3, CuO, ZnO and SiO2) through rib-groove channel. Under steady temperature go, the calculations are performed for various sorts of nanoparticles with various volume portions (extend 1-4%) utilizing four diverse rib-groove shapes.

Fig: 1

TYPES OF NANO FLUIDS:

There are different types of nano fluid;
Basically Al2O3 + water
CuO + water
TiO + water
CH3CH2OH + water
Out of these we are going to use Al2O3 & water as our nano fluid in heat exchanger.

Basic Heat Exchanger Flow Arrangements

Parallel Flow:

A double pipe heat exchanger can be operated in parallel flow mode as shown in the diagram

Parallel flow by having both fluids enter at one end and exit at the other end. With parallel flow the temperature difference between the two fluids is large at the entrance end, but it becomes small at the exit end as the two fluid temperatures approach each other. The overall measure of heat transfer driving force, the log mean temperature difference is greater for counter flow, so the heat exchanger surface area requirement will be larger than for a counter flow heat exchanger with the same inlet and outlet temperatures for the hot and the cold fluid.

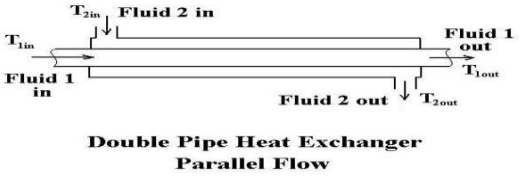

Fig: 2

Counter flow:

A counter flow heat exchanger has the hot fluid entering at one end of the heat exchanger flow path and the cold fluid entering at the other end of the flow path. Counter flow is the most common type of liquid-liquid heat exchanger, because it is the most efficient. A double pipe heat exchanger is usually operated as a counter flow heat exchanger, as shown in the diagram.

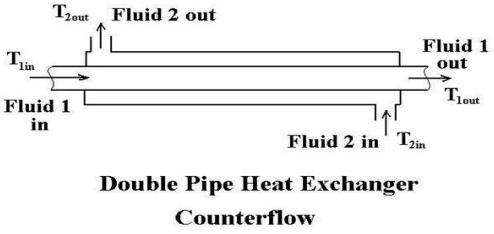

Fig: 3

EXPERIMENTAL SETUP AND FABRICATION

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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.
7. 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.

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CALUCULATIONS

MESH TYPE 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
50	32	33	32
57	35	31	42
60	29	34	42

Effectiveness (ε) = 0.161

$$= \frac{Tco - Tci}{Thi - Tci} = \frac{34-29}{60-29} = 0.161$$

MESH TYPE 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
60	30	32	48
61	31	39	52
60	31	41	53

Effectiveness (ε) = 0.34

$$= \frac{Tco - Tci}{Thi - Tci} = \frac{41-31}{60-31} = 0.34$$

MESH TYPE 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
60	40	36	48
58	39	38	46
57	36	41	42
57	36	45	30

Effectiveness (ε) = 0.42

$$= \frac{Tco - Tci}{Thi - Tci} = \frac{45-36}{57-36} = 0.42$$

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MESH TYPE 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
51	33	34	30
59	35	38	30
60	32	46	38
60	30	53	40

Effectiveness $(\varepsilon) = 0.76$

$$= \frac{Tco-Tci}{Thi-Tci} = \frac{53-30}{60-30} = 0.76$$

HEAT EXCHANGER WITH OUT MESH AND 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 $(\varepsilon) = 0.157$

$$= \frac{Tco-Tci}{Thi-Tci} = \frac{34-31}{50-31} = 0.157$$

HEAT EXCHANGER WITH OUT MESH AND WITHOUT 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 $(\varepsilon) = 0.1875$

$$= \frac{Tco-Tci}{Thi-Tci} = \frac{40-37}{53-37} = 0.1875$$

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) = 0.227

$$= \frac{Tco-Tci}{Thi-Tci} = \frac{40-35}{57-35} = 0.227$$

HEAT EXCHANGER WITH OUT MESH 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 mesh 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.

REFERENCES

[1] deNevers, N., Fluid Mechanics, McGraw Hill, (1991).

[2] Emerson Process Management product guide.http://www.emersonprocess.com/ brooks/ products/products3d.html (accessed Sept 2002).

[3] Paisarn Naphon and Tanapon Suchana et al. "Heat transfer enhancement and pressure drop through the horizontal concentric tube with twisted wire brush inserts", International Communications in Heat and Mass transfer, Volume 38, pp. 236-241, 2011.

[4] P. S. Amrutkar, S. R. Patil, "Automotive Radiator Performance-Review", International Journal of Engineering and Advanced Technology, Volume-2, Issue-3, Feb-2013

[5] Patel.H.E, Das.S.K, Sundarrajan.T, Sreekumaran Nair.A, George.B and Pradeep.T, "Thermalconductivities of naked and manolayer protected metal nanoparticle based Nanofluids, Manifestation of anomalous enhancement and chemical effects", Applied Physics Letters, 83(2003), 14, pp. 2931 – 2933.

[6] M. I. Hasan, A. A. Rageb, M. Yaghoubi and H. Homayony, "Influence of Channel Geometry on the Performance of Counter Flow Microchannel Heat Exchanger," International Journal of Thermal Sciences, Vol. 48, No. 8, 2009, pp. 1607-1618.

[7] Keblinst.P, Eastman.J.A and Cahill.D.G,"Nano fluids for Thermal Transport" Materials Today, 8 (2005), 6, pp. 36-44.

[8] J. Lee and I. Mudawar, "Assessment of the Effectiveness of Nanofluids for Single-Phase and TwoPhase Heat Transfer in Micro-Channels," International Journal ofHeat and Mass Transfer, Vol. 50, No. 3-4, 2007, pp. 452-463

[9] Tran.P.X and Soong.Y, "Preparation of nanofluids using laser ablation in liquid technique", ASME Applied Mechanics and Material Conference, Austin, TX – 2007.

[10] N. Tsolas, S. Chandra, H.R. Salimi Jazi, J. Mostaghimi, and L. Pershin, Thermal Spray Forming of High-Efficiency, Metal-Foam Heat Exchanger Tubes, *International Thermal Spray Conference & Exposition.*, May 3-5, 2010 (Singapore)

[11] H.R. Salimi Jazi, J. Mostaghimi, S. Chandra, L. Pershin, and T. Coyle, Spray-Formed, Metal-Foam Heat Exchangers for High Temperature Applications, *J. Therm. Sci. Eng.*, 2009, **1**(3), p 031008.1-031008.7

[12] K. Boomsma, D. Poulikakos, and F. Zwick, Metal Foams as Compact High Performance Heat Exchangers, *Mech. Mater.*, 2003, **35**(2), p 1161-1176

[13] N. Efford, *Digital Image Processing: A Practical Introduction Using Java*, Addisopn Wesley, Exxex, 2000

[14] S. P. Jang and S. U. S. Choi, " Cooling Performance of a Microchannel Heat Sink with Nanofluids," Applied Thermal Engineering, Vol. 26, No. 17-18, 2006, pp. 2457-2463

[15] I. M. Shahrul, I. M. Mahbubul, R. Saidur, S. S. Khaleduzzaman, M. F. M. Sabri, and M. M. Rahman, Effectiveness Study of a Shell and Tube Heat Exchanger Operated with Nanofluids at Different Mass Flow Rates, Numerical Heat Transfer, Part A Applications: An International Journal of Computation and Methodology, Volume 65, Issue 7, 2014, pages 699-713.

[16] Shive Dayal Pandey and V.K. Nema, Experimental analysis of heat transfer and friction factor of nanofluid as a coolant in a corrugated plate heat nanofluid as a coolant in a corrugated plate heat exchanger, Experimental Thermal and Fluid Science Volume 38, April 2012, Pages 248-256.

[17] F.S. Javadi, S. Sadeghipour, R. Saidur, G. BoroumandJazi, B. Rahmati and M.M. Elias, M.R. Sohel, The effects of nanofluid on thermophysical properties and heat transfer characteristics of a plate heat exchanger,International Communications in Heat and Mass Transfer, Volume 44, May 2013, Pages 58-63.

[18] Dr. M K Chopra, Ramjee Singh Prajapati, Bhopal, Jan 2014, Thermal performance analysis of cross-flow unmixed-unmixed heat exchanger by the variation of inlet condition of hot fluid. International Refereed Journal of Engineering and Science (IRJES)

[19] Navid Bozorgan, Mostafa Mafi, and Nariman Bozorgan, Iran, aud 2012 Performance Evaluation of AI2O3/Water Nanofluid asCoolant in a Double-Tube Heat Exchanger Flowing under

[20] KEVIN M. LUNSFORD, Texas, Increasing Heat Exchanger Performance publishers Bryan Research & Engineering, Inc., Bryan, Texas

[21] R. Chein, J. ChuangExperimental microchannel heat sink performance studies using nanofluids

[22] Eastman J.A, Choi S.U.S, Li. S, Yu.W and Thompson L.J."Anomalously increased Effective thermal conductivities of ethylene glycol-based nanofluids conducting copper nanoparticles."Applied Physics Letters. 78(2001), 6, pp. 718-720

[23] Kavitha T, Rajendran A, Durairajan A, Shanmugam A, "Heat Transfer Enhancement Using Nano Fluids and Innovative Methods - An Overview", International Journal of Mechanical Engineering & Technology (IJMET), Volume 3, Issue 2, 2012, pp. 769 - 782,

ISSN Print: 0976 – 6340, ISSN Online: 0976 – 6359.

[24] Ruch, D. (2001)"Thermal/Fluid Characteristics Of 3-D Woven Mesh Structures As Heat Exchanger Surfaces", MS Thesis, M. E. Dept, Univ. Nevada, Reno NV 89557.

[25] Chang, W.S. (1990) "Porosity and Effective Thermal Conductivity of Wire Screens", J. Heat Transfer, Vol. 112, pp. 5 - 9.

[26] Kaviany, M. (1995) Principles of Heat Transfer in Porous Media, 2nd ed., Springer.

[27] Siegel, Byron L. : Design and Operation of a High-Temperature Tungsten-Mesh Gas Heater. NASA TM X-1466, 1967.

[28] London, A. L. ; Mitchell, J. W. ; and Sutherland, W. A. : Heat-Transfer and FlowFriction Characteristics of Crossed-Rod Matrices. J. Heat Transfer, vol. 82, no. 3, Aug. 1960, pp. 199-213.

[29] Maag, William L. ; and Mattson, William F. : Forced-Convection Heat-Transfer Correlation for Gases Flowing Through Wire Mesh at Surface Temperatures to 5500' R. NASA TN D-3956, 1967.

[30] McAdams, William H. : Heat Transmission. Third ed., McGraw-Hill Book Company, Inc., 1954.

[31] Gedeon, Louis; and Grele, Milton D. : Forced-Convection Heat-Transfer and Pressure-Drop Characteristics of a Closely Spaced Wire Matrix. E54D12, 1954.

[32] M. Greiner, P.F. Fischer, H.M. Tufo, Two-dimensional simulations of enhanced heat transfer in an intermittently grooved channel, Trans. ASME J. Heat Transfer 124 (2002) 538–545.

[33] W.M. Kays, A.L. London, Heat-transfer and flow-friction characteristics of some compact heat-exchanger surfaces—Part I, Trans. ASME 72 (1950) 1075–1085

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