Performance Analysis of Efficient Heat Flow by Compact types Heat Exchanger

[1]Vishal Srivastava, [2]Dr.Sohail Bux
[1]M. Tech Scholar, [2]Professor
[1]Department of MechanicalEngineering, Agnos College of Technology Bhopal, (M.P.)
[2]Department of MechanicalEngineering, Agnos College of Technology Bhopal, (M.P.)
Email-: [1]vishal1912@gmail.com,[2]buxsohail@gmail.com.com

Abstract- Compact heat exchangers are one of the most critical components of many cryogenic components; they are characterized by a excessive heat transfer surfacearea per unit volumeof theexchanger. The heat exchangers having surfacearea density (β) greater than seven hundred m2/m3 in either oneor more sides of two-stream or multi stream heat exchanger is called as a compact heat exchanger. Platefin heat exchanger is a typeof compact heat exchanger which is widely used in automobiles, cryogenics, spaceapplications and chemical industries. The platefin heat exchangers are mostly used for the nitrogen liquefiers, so they need tobehighly efficient becausenoliquid nitrogen is produced, if theeffectiveness of heat exchanger is less than 87%. Soit becomes necessary to test theeffectiveness of these heat exchangers before setting them in tooperation

Keywords: Performance Analyis, Heat glide, Heat exchanger

1. Introduction

A heat exchanger is a device to transfer heat from a hot fluid to cold fluid across an impermeable wall. Fundamental of heat exchanger principle is to facilitatean efficient heat flow from hot fluid to cold fluid. This heat flow is a direct function of the temperature difference between the two fluids, thearea where heat is transferred, and the conductive/convective properties of the fluid and the go with the flow stat. This relation was formulated through Newton and referred to as Newton's law of cooling, that is given in Equation (1)

Q=h*A*□T (1)……………….(1)

Where h is the heat transfer coefficient [W/m2K], where fluid's conductive/convective properties and the flow state comes in the picture, A is the heat transfer area [m2], and T is the temperature difference [K].Figure.1 shows the basic heat transfer mechanism.[1]

Heat exchangers areoneof the vital components in diverse engineering plants and systems. So the design and construction of heat exchangers is often vital for the proper functioning of such systems. It has been shown in that the low temperature plant life based on Lind

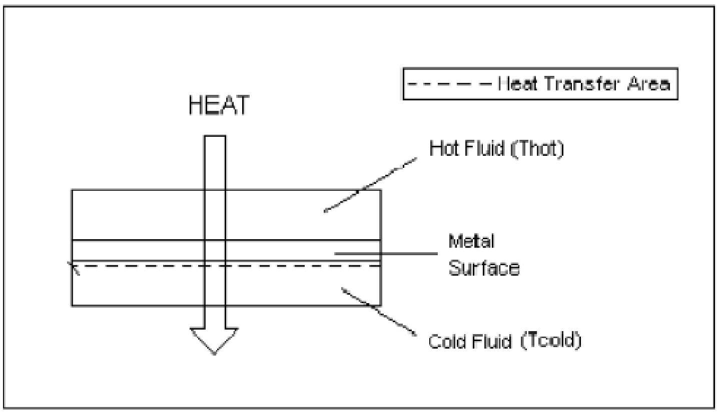

Fig. 1 Basic heat transfer mechanism

Hampson cycle cease to produce liquid if the effectiveness of the heat exchanger is below 86.9%. On theother hand in aircrafts and automobiles, for a given heat obligation, the volumeand weight of the heat exchangers should beas minimal as possible.[2]

So the main requirement for any heat exchanger is that it should beable to transfer the required amount of heat with a very high effectiveness. In order to increase the heat transfer in a basic heat exchanger mechanism shown below in Figure 1, assuming that the heat transfer coefficient cannot be changed, theareaor the temperature differences have to be increased. Usually, the best solution is that the heat transfer surfacearea is extended although increasing the temperature difference is logical, too. In reality, it may not be lots meaningful to increase the temperature difference becauseeither a hotter fluid should be supplied to the heat exchanger or the heat should be transferred toa colder fluid where neither of them are usually available. For both cases either to supply the hot fluid at high temperatureor cold fluid at lower temperatureextra work has to be done. Furthermore increasing the temperature difference more than enough will cause unwanted thermal stresses on the metal surfaces between two fluids. This usually results in the deformation and also decreases the life span of those materials. As a result of these facts, increasing the heat transfer surfacearea generally is the best engineering approach.[3]

Theabove requirements have been the motivation for the development of a separate class of heat exchangers known as Compact heat exchangers. These heat exchangers havea very excessive heat transfer surfacearea with respect to their volumeand areassociated with high heat transfer coefficients. Typically, the heat exchanger is called compact if the surfacearea density (β) i.e. Heat transfer surfacearea per unit volumeis greater than seven-hundred m2/m3 in either oneor more sides of two-stream or multi stream heat exchanger. The compact heat exchangers are lightweight and also have a lot smaller footprint, so they are exceptionally desirablein manyapplications.[4]

2. Literature review

Recovering the thermal power contained in waste warmth that is expelled from an interplay at a temperature sufficiently higher than the ambient temperature may be done profitably for some of programs. Various experiments have been performed within the place to check various techniques of electricity regulation and framework improvement.

Heat Exchangers, a bit of hardware designed for efficient hotness transfer from one medium to any other, had been studied with the aid of [5]. A stable wall may separate the media a good way to save you any mixing or any interplay among them. Heat exchangers are broadly used in industries such space heating and cooling, strength technology, synthetic chemistry, petro chemistry, oil refining, and sewage remedy. An automobile radiator is a not unusual instance of a warmness exchanger, since it transfers warmth from the engine's hot cooling liquid, water, to the air passing via the radiator. It is normally agreed that the plate warmth exchanger is the maximum realistic and cost-effective technique of moving heat between fluids. Its low rate, versatility, little protection, and brilliant warmness performance make it the quality warmness exchanger to be had.

The efficiency of a fireplace tube kettle with a very good front and screw conveyance for handling gas changed into investigated by means of [6]. Pipe gasoline heat for gas drying, preheated air for burning, and adjusting the degree of air for gas ignition prior to coming into the ignition chamber the use of the fluffy logical manipulate calculation had been crucial to the efficiency advantage. The results of the exams confirmed that heater productivity went raised through zero.41% and fuel moisture content went down by means of three% wt whilst warmness restoration and gas drying were used. When air is preheated via 35 ranges Celsius, evaporator performance will increase via 0.Seventy two percent. With a mean air-control accuracy of 89.15%, the kettle's competency expanded by way of four.34%. When all 3 structures are put to use concurrently, a five.15 percentage boom in kettle performance, or a every year financial savings of 246.88 heaps of gasoline, is viable.

Consequently, they directed a contextual inquiry to enhance the performance of a fireplace tube heater the usage of rigid fuel on this observe's kettle.[7]

It appeared on approaches to apply renewable strength and advanced the performance of thermodynamic cycles. The growing public focus of energy and environmental worries has inspired a growing range of analysts to pursue careers in this region. Utilizing waste heat from renewable energy assets like biomass, geothermal, and sun with the usage of the natural Rankine cycle (ORC) is a sensible invention. In addition, the (waste) heat from other cycles may be protected into those as well. There has been a large uptick within the quantity of studies examining the capacity of herbal Rankine cycle (ORC) enhancements for secondary heat valorization. Power era was carried out by way of skillfully coordinating a small-scale ORC with a internet capability of 3 kW with a concentrated solar energy technology. The considerable heat supply from Photovoltaic (PV) authority turned into used via a supercritical hotness exchanger the use of R-404A as the operating medium, with a maximum temperature of a hundred C. A higher warm match within the warmth exchanger and increased common cycle productivity are both consequences of making sure supercritical hot-water glide. Using the written connections For warmth transfer, a helical loop heat exchanger became designed.[8]

3. Detailed Description of numerous Equipment’s and Instruments used

Air is used as theas working fluid on this experiment. Theapparatus was connected toa compressor system that is capableof continuously delivering dry air .The compressed air from the compressor enters the laboratory through a control valve which is used toregulate theflow rate through the heat exchanger and then routed to the testing heat exchanger.

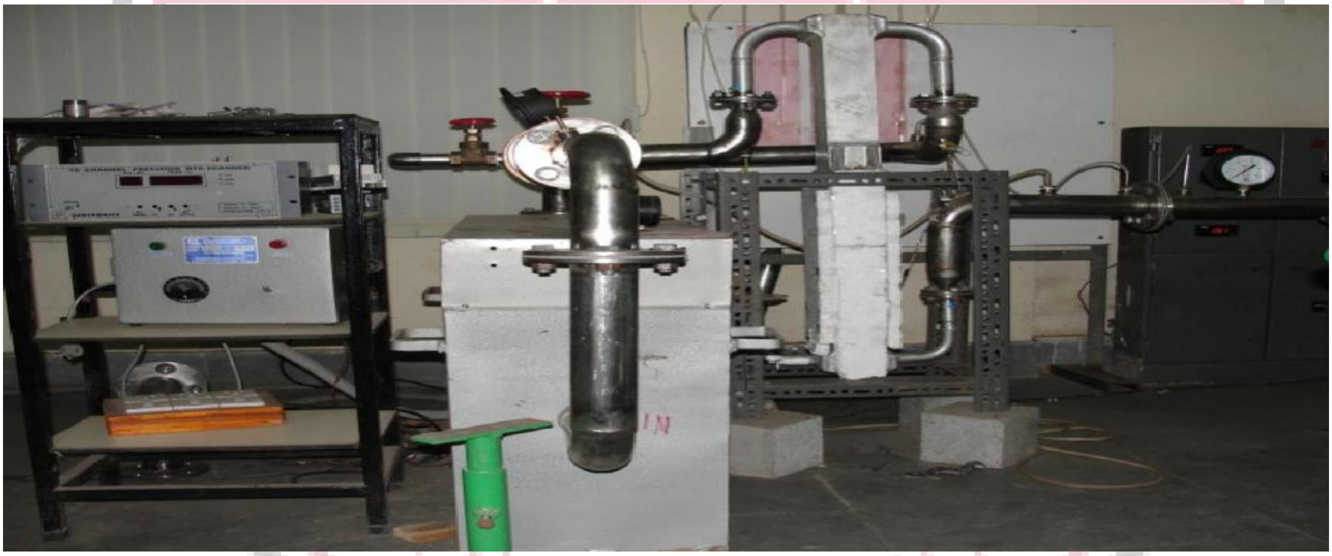

Fig.2 Photograph of the Experimental Setup

Table experimentally observed data.

Flow Rate (litr/min)	**P1 (Kg/cm^2)**	**P2 (Kg/cm^2)**	**Δ c (mm of Hg)**	**Δ h (mm of Hg)**	T1 (C)	T2 (C)	T3 (C)	T4 (C)
300	0.08	0.06	9	6	42.24	87.34	96.2	47.15
400	0.14	0.12	15	12	38.35	87.02	95.12	43.01
500	0.2	0.17	25	22	38.93	88.49	96.12	43.11
550	0.24	0.20	30	26	39.82	88..83	96.66	43.48

588	0.28	0.24	31	27	40.41	88.45	96.20	43.99
650	0.32	0.26	40	35	41.16	87.86	95.95	44.17
300	0.08	0.06	8	6	40.92	62.06	66.48	43.06
400	0.135	0.10	16	14	42.77	62.90	66.43	44.56
500	0.2	0.16	24	22	39.57	62.52	66.02	41.69
600	0.28	0.23	31	30	39.94	62.44	65.98	41.73
650	0.34	0.28	37	34	42.72	62.77	66.34	44.06

3. Result and Discussion

Figure three and four shows the variation of effectiveness obtained experimentally as well as with theoretical correlations and that obtained with simulation softwareAspen with mass flow rate. It is seen that in both the cases effectiveness increases with mass flow rate. Experimental

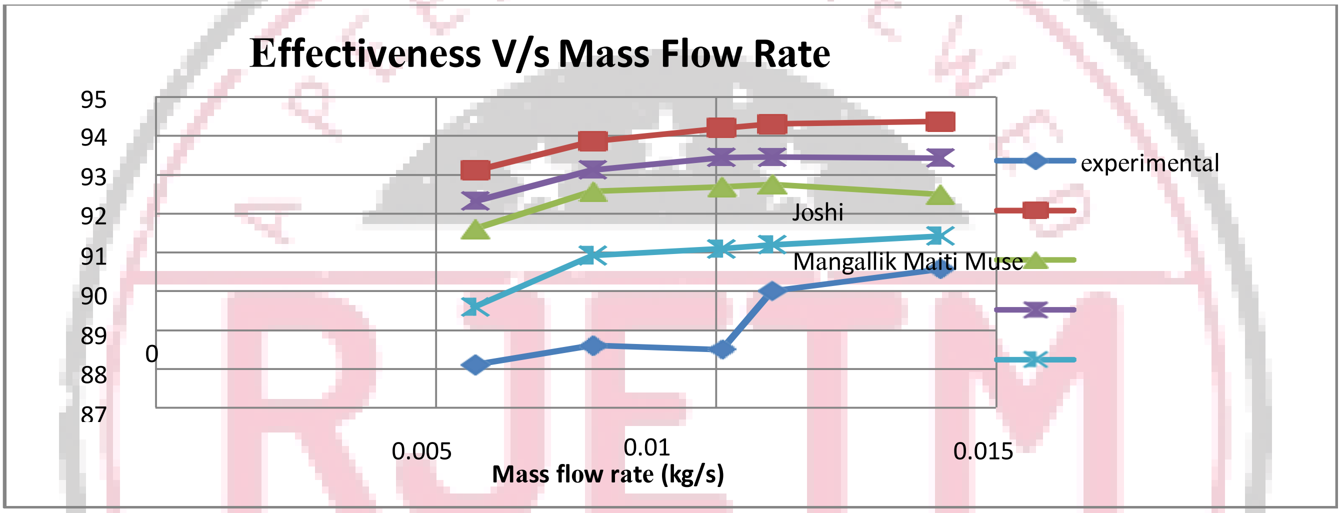

Fig. 3 Variation of effectiveness with mass flow rate (hot inlet temperature)

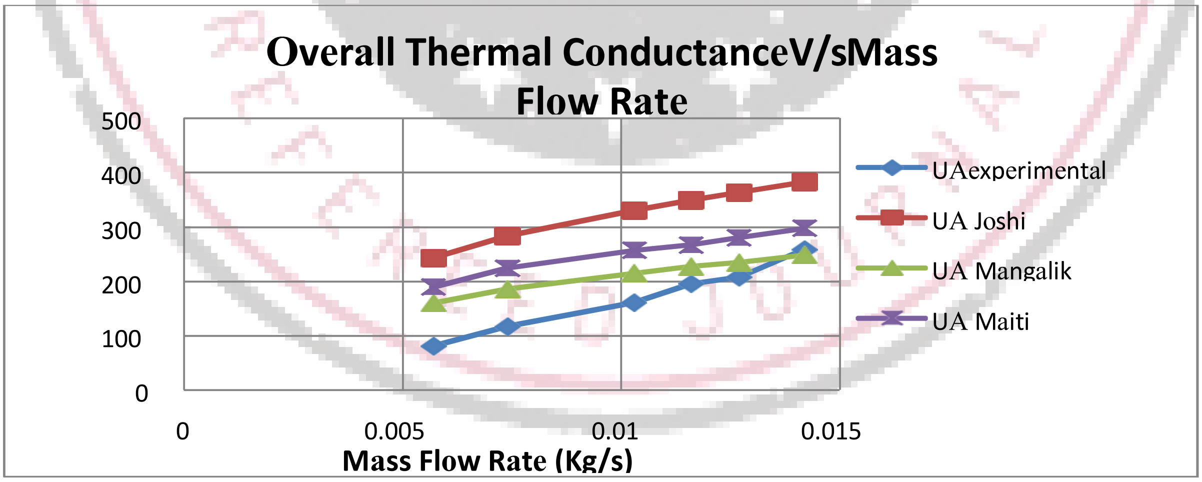

Fig. 4. Variation of overall thermal conductance with mass flow rate

4. Conclusions

The hot test is conducted todeterminethe thermal performance parameters of theavailable platefin heat exchanger at different mass flow rates and two different hot inlet temperatures of ninety six and 66C. An averageeffectiveness of ninety one% is obtained. It is found in both the cases that theeffectiveness and overall thermal conductance increases with increasing mass flow rate It is alsofound that hot fluid effectiveness increases with flow rateof thefluid and agrees within 4% with theeffectiveness valuecalculated by way of different correlations and that obtained by the usage of the simulation software, Aspen. Alsothe pressure drop increases with increasing mass flow rateand experimental values are moreas compared to theoretical results because the losses in pipes and manufacturing irregularities havenot been taken in toaccount.

For a particular hot inlet temperature there is an optimum mass flow rateat which the difference between the hot and cold effectiveness of the heat exchanger is minimum and at this point the imbalance is also minimum. We found that the insulation which is provided in the heat exchanger has a significant effect on its performance. It is expected that the imbalance i.e. Difference between the hot and cold end temperature can be brought toa minimum level if a perfect insulation like vacuum is provided.

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