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"Experimental Study of Air Cooled Condenser Using Fans With Various Blades"

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Abstract: An experimental set up is made for an air-cooled condenser and a heat exchanger for observing the water flow rate using different types of fans with various number of blades. The comparisons are done between various quantities like pressure of steam, water flow rate, speed of fan, no. of blades of fan and temperature difference of hot and cold water and air inlet and air outlet. It is found that water flow rate increases with increase in the speed of fan and also increases with decreasing no. of blades. So using the fan with less no. of blades we can get better results.

Index Terms -Fans, Blades, Temperature, Hot and Cold Water, Inlet, Air outlet, Heat Exchanger

1. INTRODUCTION

Heat transfer is a discipline of thermal engineering that concerns the generation, use, conversion, and exchange of thermal energy and heat between physical systems. As such,heat transfer is involved in almost every sector of the economy. Warmth move is groupedinto different components, for example, warm conduction, warm convection, warm radiation and move of energy by stage changes. Specialists likewise consider the exchange of mass of contrasting synthetic species, either cold or hot, to accomplish heat move. While these components have unmistakable attributes, they regularly happen at thesame time in a similar framework.

Warmth conduction, likewise called dissemination, is the direct infinitesimal trade of active energy of particles through the limit between two frameworks. At the point when an article is at an alternate temperature from another body or its environmental factors, heat streams so the body and the environmental factors arrive at a similar temperature, so,all in all they are in warm balance. Such unconstrained warmth move consistently happens from an area of high temperature to another locale of lower temperature, as depicted constantly law of thermodynamics.

Warmth convection happens when mass progression of a liquid (gas or fluid) conveys heat alongside the progression of issue in the liquid. The progression of liquid might be constrained by outside cycles, or now and then (in gravitational fields) by lightness powers caused when nuclear power extends the liquid (for instance in a fire tuft), hence impacting its own exchange. The last interaction is frequently called "characteristic convection". All convective cycles likewise move heat incompletely by dispersion, also. Another type of convection is constrained convection. For this situation the liquid is compelled to stream by utilization of a siphon, fan or other mechanical methods.

Warm radiation happens through a vacuum or any straightforward medium (strong or liquid). It is the exchange of energy by methods for photons in electromagnetic waves administered by similar laws is characterized in material science as the exchange of nuclear power across a very much characterized limit around a thermodynamic framework. It is an attribute of a cycle and is rarely contained in issue. In designing settings, notwithstanding, the term heat move has gained a particular utilization, in spite of its exacting repetition of the portrayal of move. In these specific circumstances, heat is taken as interchangeable to nuclear power. This use has its root in the verifiable translation of warmth as a liquid (caloric) that can be moved by different causes, and that is likewise normal in the language of laymen and regular daily existence.

1.1 Mode of Heat Transfer

1.**Conduction** : heat conduction happens as hot, quickly moving or vibrating iotas andparticles connect with adjoining molecules and atoms, moving a portion of their energy (heat) to these adjoining particles. As such, heat is moved by conduction when nearby iotas vibrate against each other, or as electrons move starting with one particle then onto the next. Conduction is the main methods for heat move inside a strong or between strongitems in warm contact. Liquids—particularly gases—are less conductive. Warm contact conductance is the investigation of warmth conduction between strong bodies in contact.

2.Convection : Convection is the exchange of warmth starting with one spot then onto the next by the development of liquids, an interaction that is basically the exchange of warmth by means of mass exchange. Mass movement of liquid upgrades heat move in

numerous actual circumstances, such as between a strong surface and the liquid. Convection is generally the prevailing type of warmth move in fluids and gases.

3.Radiation: Thermal radiation is energy radiated by issue as electromagnetic waves, because of the pool of nuclear power on the whole matter with a temperature above supreme zero.Warm radiation spreads without the presence of issue through the vacuum of room.Warm radiation is an immediate consequence of the arbitrary developments of particles and atoms in issue. Since these iotas and atoms are made out of charged particles(protons and electrons), their development brings about the outflow of electromagnetic radiation, which diverts Energy from the surface. Radiation from the sun, or sun oriented radiation, can be gathered for warmth and force.

2. LITERATURE REVIEW

GENERAL

In the plan cycle, the planner needs to rehearse different significant undertakings like conceptualizing, work examination, morphological outline, synectics, and investigation of interconnected choice zone (AIDA) and so on of summoning plan thoughts. Meanwhile, a couple of scientists proposed hypotheses for programmed creating item shapes. Notwithstanding, they were totally centered around portraying the surface mixing strategy, and only here and there thought about an association with figuring out. For a programmed item configuration age commonly a parametric shape mixing technique was utilized.

PAST RESEARCH WORK.

Some researcher's work, which is useful for work, is discussed below:

Li et al. (2011) proposed a technique called 2D bend mixing strategy, which has been utilized to blend 3D configuration by considering the blueprints of 2D bends. This strategy is planned by considering the highlights of all 2D bends which can be utilized for mixing surfaces and afterward setting up the comparing connections among the highlights.

Li et al. (2014) utilized the glass tangle thermoplastic (GMT) composite material which comprised of unidirectional glass fiber strengthened plastic (GFRP) layers and the woven type of GFRP layers for the guard shaft because of its incredible engrossing limit of effect energy and less weight than the customary metallic materials.

Hosseinzadeh et al. (2016) dissected the presentation of guard pillar made of glass fiber fortified plastic (GFRP) and recommended carbon fiber strengthened plastic (CFRP) as a substitute for guard bar when contrasted with the GFRP, CFRP has the higher explicit strength under high effect burden and still it decreases the heaviness of guard shaft. Be that as it may, the solitary constraint is the carbon fiber is an excess of costly contrasted with glass fiber composites to supplant whole construction of guard pillar. Thinking about the material expense, at long last they investigated the material, for example making out of carbon fiber and the glass fiber together into the guard shaft and closed the blended material decreased the heaviness of the segment and improved the effect execution all the while.

Do et al. (2017) thought about the half and half glass/carbon tangle thermoplastic (GCMT) which is made out of unidirectional and woven type of glass/carbon fiber strengthened plastic layers in the spot of customary GMT composite for guard bar and different plans of glass/carbon tangle thermoplastic (GCMT) were contrived. The mechanical properties of GCMT were determined by old style covers plate hypothesis (CLPT) and Finite Element Analysis (FEA) and utilizing the lGA calculation with the effect reenactment the ideal plan of guard bar was distinguished, produced and sway exhibitions were estimated. Ideally planned guard pillar made of GCMT has 33% less weight instead of the customary GMT material and indicated improved effect exhibitions.

Rana et al. (2018) broke down Fiber-fortified polymer composites and portrayed FRP material has high-strength because of their high firmness to weight proportion. Because of their simplicity of handling it has been broadly utilized in expanded fields, for example, aviation, car, development, and sporting gear material applications.

Zhang et al. (2018) examined the properties of thermosetting polymer lattice, epoxy sap and induced that they have a progression of intriguing qualities like great solidness, high modulus and strength, high warm opposition and protection from creep and anyway it too shows a profoundly unfortunate property, for example helpless protection from break inception and engendering.

Boroujeni et al. (2019) showed that the epoxy lattice alongside carbon nanotubes or nanofibers could expand the durability of the grid and improve the mechanical and crack properties of the composites.

Rodriguez et al. (2019) created Multi scale FRCs by electrophoretic affidavit of carboxylic corrosive or amine functionalized carbon nanofibers (CNFs) on the outside of measured or unsized carbon fiber layers and explored the mechanical properties of the multiscale fortification texture. They uncovered through the examination that a 12% upgrade in interlaminar shear strength and a 13% improvement in compressive strength for boards containing amine-functionalized CNFs.

Mojtaba et al. (2019) researched the elastic and flexural properties of epoxy gum and the impacts of CNFs (nano-size) and the mix of CNFs and UHMWPE fiber (miniature size) composites. Through the interaction of ultrasonication and rapid mechanical mixing, Carbon nanofibers (CNFs) were scattered in epoxy pitches and utilizing the optical magnifying lens they have dissected the scattering conduct of CNFs in the epoxy lattice. Impact on the ductile properties of epoxy nanocomposites was examined and reasoned that the most noteworthy improvement in strength was acquired with the 1.0 wt % stacking of CNF.

Sambhrant et al. (2019) considered a blended stream siphon impeller edges with two diverse cutting edge situating in the meridional annulus and the FEM investigation have been executed to assess the created stresses in the siphon edges. To upgrade the thickness of the air foil sharp edge cross-segment as for Von-misses pressure an Artificial Neural Network has been utilized. It is seen that the blended stream siphon impeller sharp edge with gulf slanted cutting edge position in the meridional annulus is more appropriate with deference trapezoidal edge as anticipated through Artificial Neural Network utilizing programming.

Javed and Asif (2020) used ANSYS for the streamlining of area and size of opening in a pressing factor vessel chamber. Investigation is done on three thick-walled chambers with 3 diverse inner distances across and surmised that the Von Misses

pressure increments as the inward breadth of chamber increments. The opening size and opening area advancement is done by making distinctive width openings and at various areas from the chamber top. Via completing Finite Element Analysis, ANSYS here, the ideal area and size is distinguished at where the Von Mises pressure is least.

Vasanthanathan et al. (2020) Vasanthanathan et al. (2014) planned a trial set up to improve the steadiness of glass texture strengthened epoxy shell structures holding with pivotal stiffeners. Crashworthy structures manufactured from composite overlay with stiffeners offered predominant energy retention when contrasted and metallic designs under compressive stacking circumstances. What's more a test material characterisation has been completed on the glass texture fortified epoxy composite under uni-hub strain. Under static and effect stacking utilizing the Finite Element Method with ANSYS-LS- DYNA programming a mathematical reenactment methodology has been depicted to the static and dynamic reaction of unstiffened glass texture fortified epoxy composite shell and hardened glass texture strengthened epoxy composite shell. The test and mathematical examinations uncovered that the glass texture fortified epoxy shells solidified with GFRP stiffeners are in a way that is better than unstiffened glass texture strengthened epoxy shell and glass texture fortified epoxy shell hardened with aluminum stiffeners. The disappointment surfaces of the glass texture strengthened epoxy composite shell structures tried under effect were inspected by SEM.

Cheng et al. (2020) did the dimensionless examination of the exhibition bend of the fan by utilizing the idea of figuring out. Chebyshev Polynomial has been utilized to improve the exhibition bend of the fan to coordinate the impedance bend of the framework and the got relating outline was utilized to foresee the working purpose of dimensionless execution bend of the fan. This examination work recorded a blunder pace of 4.97% which is not exactly that of the ordinary methodology and notwithstanding this the recommended strategy has a few favorable circumstances like diminishing the expense of experimentation or reenactment, quickening the speed of working point search and lessening the size of the fan databank.

3. EXPERIMENTAL INVESTIGATION

Fig3.1 Experimental set-up

FAN- Fan is utilized to deliver the constrained convection. Constrained convection is a component, or sort of transport in which smooth movement is by an outer source(like a siphon, fan, pull gadget, and so forth) It ought to be considered as one of the principle strategies for helpful warmth move as critical measures of warmth energy canbe moved effectively and this component is discovered generally in regular day to day existence, including focal warming, cooling, steam turbines and in numerous different machines. Constrained convection is regularly experienced by engineers planning or investigating heat exchangers, pipe stream, and stream over a plate at an unexpected temperature in comparison to the stream (the instance of a bus wing during reemergence, for instance). In any case, in any constrained convection circumstance, some measure of characteristic convection is consistently present at whatever point there are g-powers present (i.e., except if the framework is in free fall). At the point when the normal convection isn't immaterial, such streams are commonly alluded to as blended convection.

STEAM GENERATOR- **A** ISI marked pressure cooker is used in place of boilerto generate steam for experimental setup .A funnel & a valve is brazed at the Top of Pressure Cooker to start and stop the supply of water in it. Also in another opening pipe is brazed to take out the steam to condenser.

HEATER-Heater is used to heat the water in the pressure cooker to produce steam which flows through the finned tube

PRESSURE GAUGE **-** Pressure gauge is used to measure the pressure in of steam which is coming out of pressure cooker in Kg/cm2

TEMPERATURE INDICATOR- Temperature indicator is a device used toindicate the temperature measured by the thermocouple wire .Thermocouple wiring: When wiring a thermocouple input, the compensation wire should be qualified anddirectly connect to the corresponding terminals in correct direction.

CRIMPED FIN TUBE- Crimped fin made of copper or aluminum. It is brazed over the tube to increase the rate of heat transfer. The components that are available on the external surface of the bare tube to increase its surface area are called fins. Finned Tubes help better transfer of heat between the outside and inside of tube. With the usage of these tubes having surface area almost eight timesof the outer tube, the length of the tube required to heat the viscous oil can be reduced by one sixth.

INSTRUMENTATION- Instrumentation Incorporate in such a way Temperature is measured through the Thermocouple wire by using Temperature indicator. Pressure is measured with the help of by pressure gauge. Different condition

1. Current and voltage are regulated with the help of regulator to control the heat.
2. Steam generator is regulated automatically to control the steam temperature.
3. Anemometer is used to measure the velocity of air at inlet and outlet of Duct

EXPERIMENTAL PROCEDURE- Most importantly water is poured in the pressing factor cooker through pipebrazed above it. The valve for entering water is then shut. At that point the Heater is turned on and water is permitted to warm. Steam is created in the pressing factor cooker which is taken out by opening the valve on opposite side of cooker .steam is taken out through lines and its pressing factor is noted with the assistance of pressing factor measure. This steam goes into finned tube fixed inside the channel and cooled by running the fan at different air-speeds .different temperaturereadings are taken with the assistance of thermocouple. The consolidated steam emergingfrom condenser is taken out in a wicker for certain time and mass stream rate is noted.

4.OBSERVATION TABLE

(a) *FOR FAN WITH 5 BLADES*

Table 1

Fan Speed	Hot WaterInlet Temp.(T1)	Cold WaterOutlet Temp.(T2)	Air Inlet(T3)	Air Outlet(T4)	PressureKg/cm2	Water flowrate (Q) in Lit/h
1	109	97	33	37	3	0.39
2	109	98	32	35	5	0.46
3	106	98	32	36	6	0.54
4	105	95	33	36	8	0.68
5	105	94	31	33	9	0.72

(b) *FOR FAN WITH 4 BLADES*

Table 2

Fan Speed	Hot WaterInlet Temp.(T1)	Cold WaterOutlet Temp.(T2)	Air Inlet(T3)	Air Outlet(T4)	PressureKg/cm2	Water flowrate (Q) in Lit/h
1	105	102	33	37	4	0.46

2	106	101	32	36	6	0.50
3	104	102	32	37	7	0.54
4	105	100	33	38	8	0.57
5	104	98	33	37	10	0.64

(c)

FOR FAN WITH 3 BLADES

Table 3

Fan Speed	Hot WaterInlet Temp.(T1)	Cold WaterOutlet Temp.(T2)	Air Inlet(T3)	Air Outlet(T4)	PressureKg/cm2	Water flowrate (Q) in Lit/h
1	110	100	35	39	2	0.54
2	106	100	35	39	4	0.57
3	103	98	34	38	5	0.64
4	103	97	34	37	7	0.72
5	105	96	33	36	8	0.80

5.RESULT

5.1 FOR FAN WITH 5 BLADES

5.1.1 TEMP DIFF OF WATER Vs WATER FLOW RATE

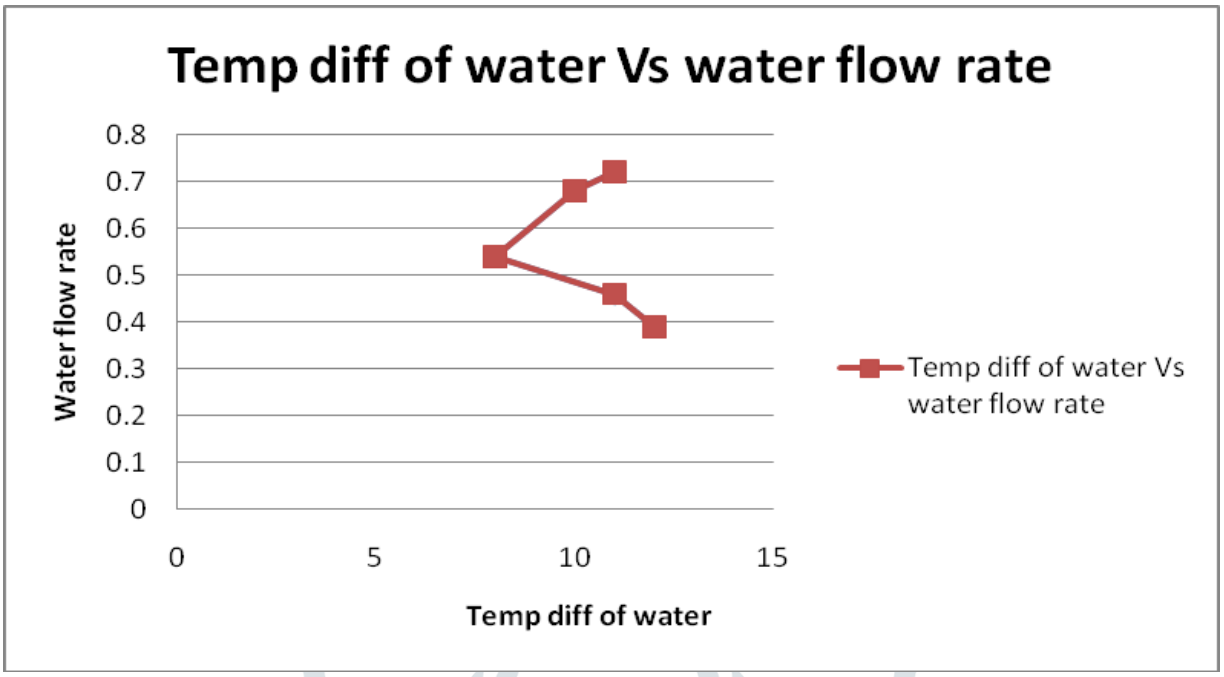


Fig 5.1

5.1.2 TEMP DIFF OF AIR Vs WATER FLOW RATE

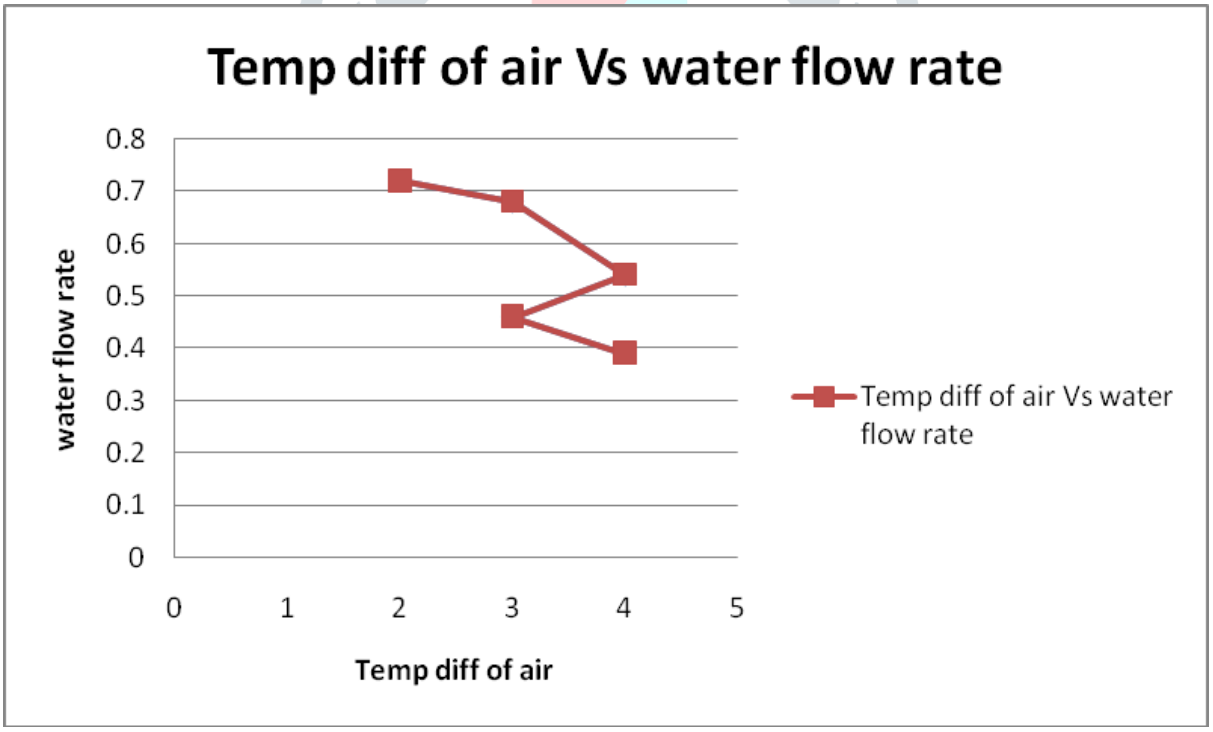


Fig 5.2

5.1.3 PRESSURE Vs WATER FLOW RATE

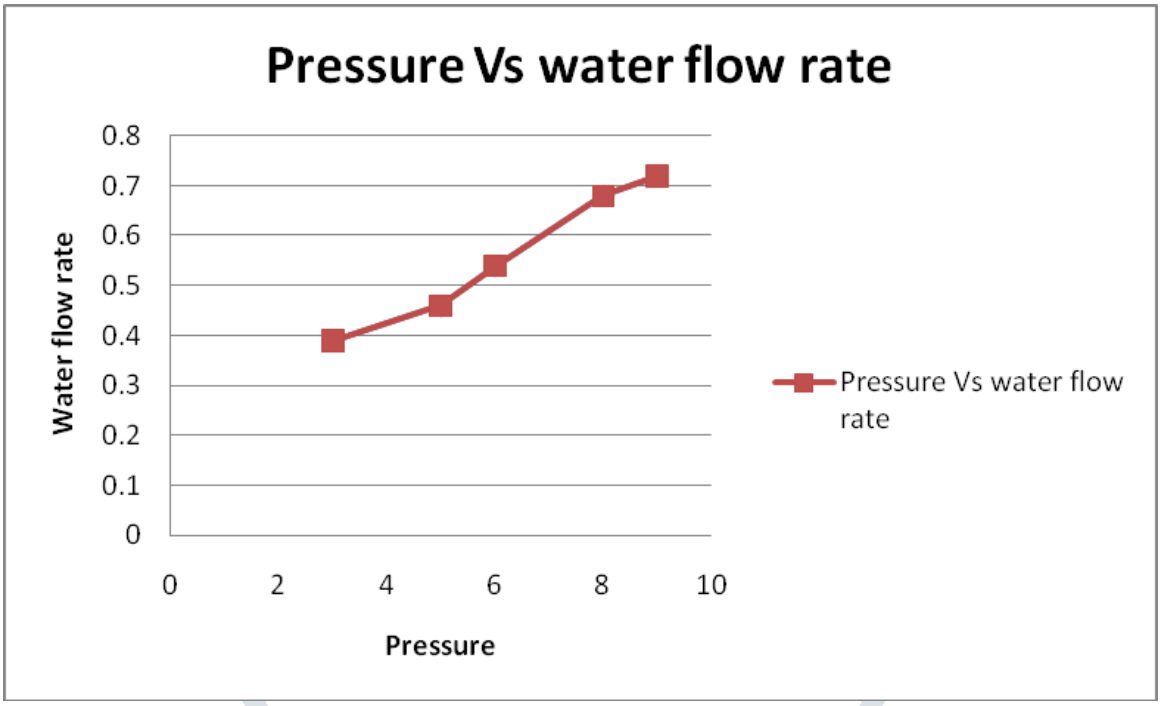


Fig 5.3

5.2 FOR FAN WITH 4 BLADES

5.2.1 TEMP DIFF OF WATER Vs WATER FLOW RATE

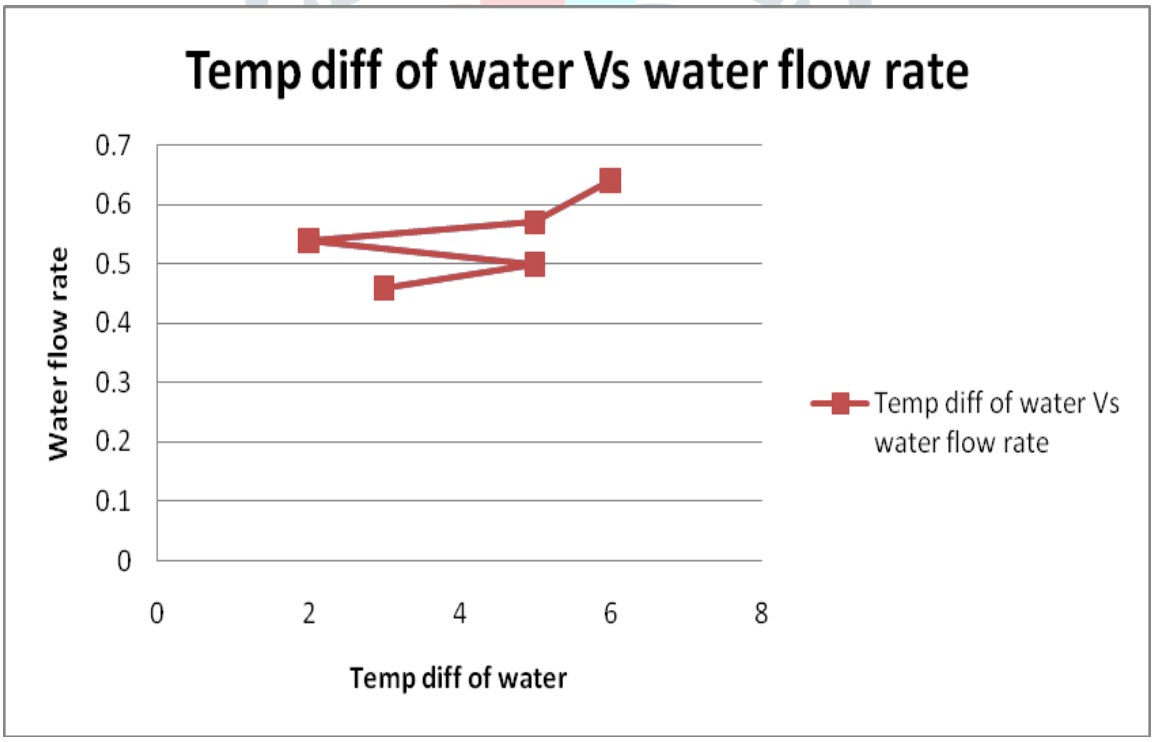


Fig 5.4

5.2.2 TEMP DIFF OF AIR Vs WATER FLOW RATE

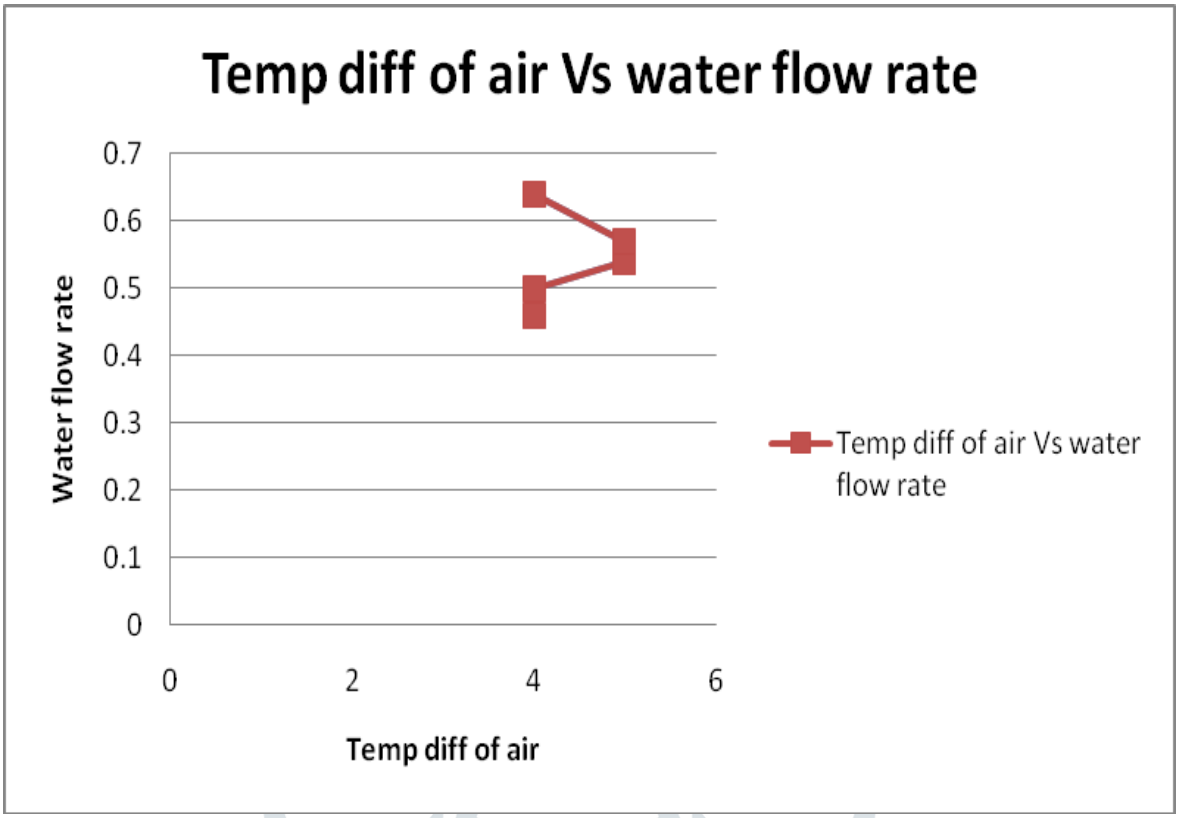


Fig 5.5

5.2.3 PRESSURE Vs WATER FLOW RATE

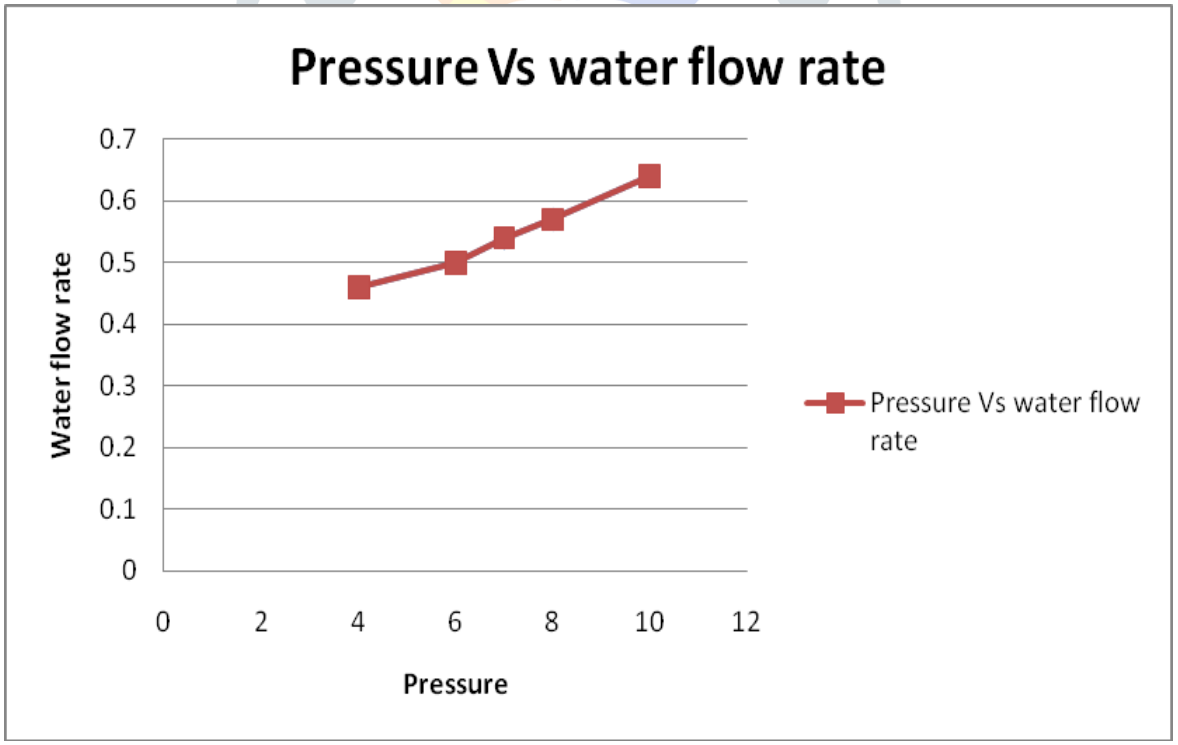


Fig 5.6

5.3 FOR FAN WITH 3 BLADES

5.3.1 TEMP DIFF OF WATER Vs WATER FLOW RATE

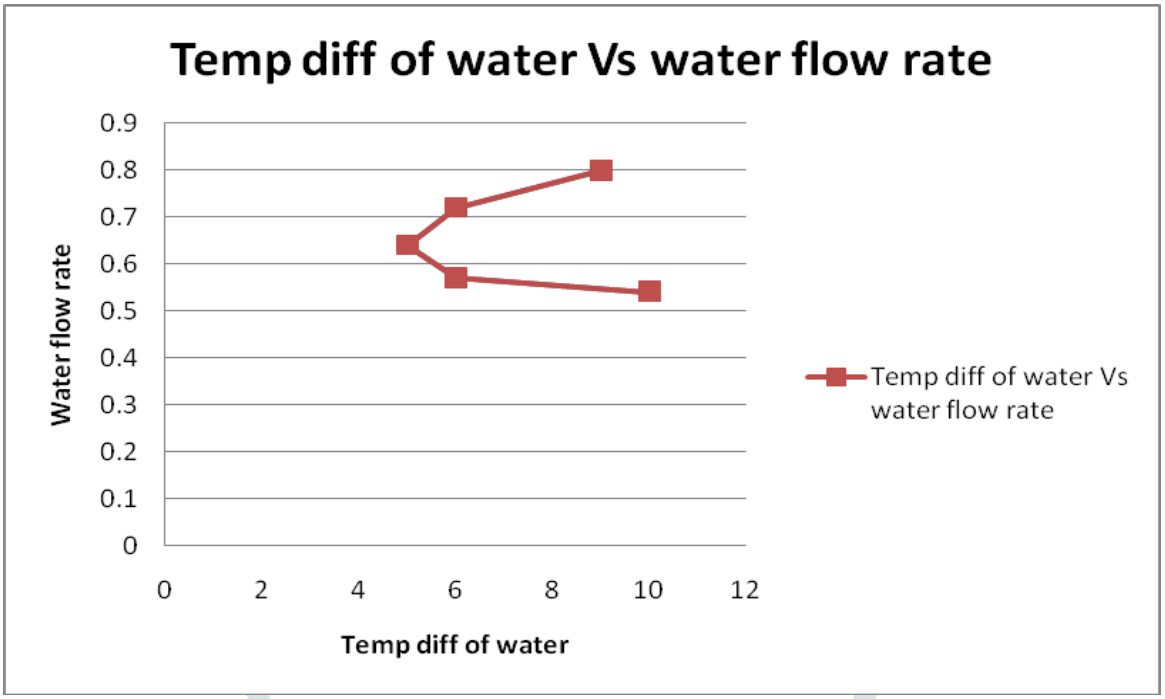


Fig 5.7

5.3.2 TEMP DIFF OF AIR Vs WATER FLOW RATE

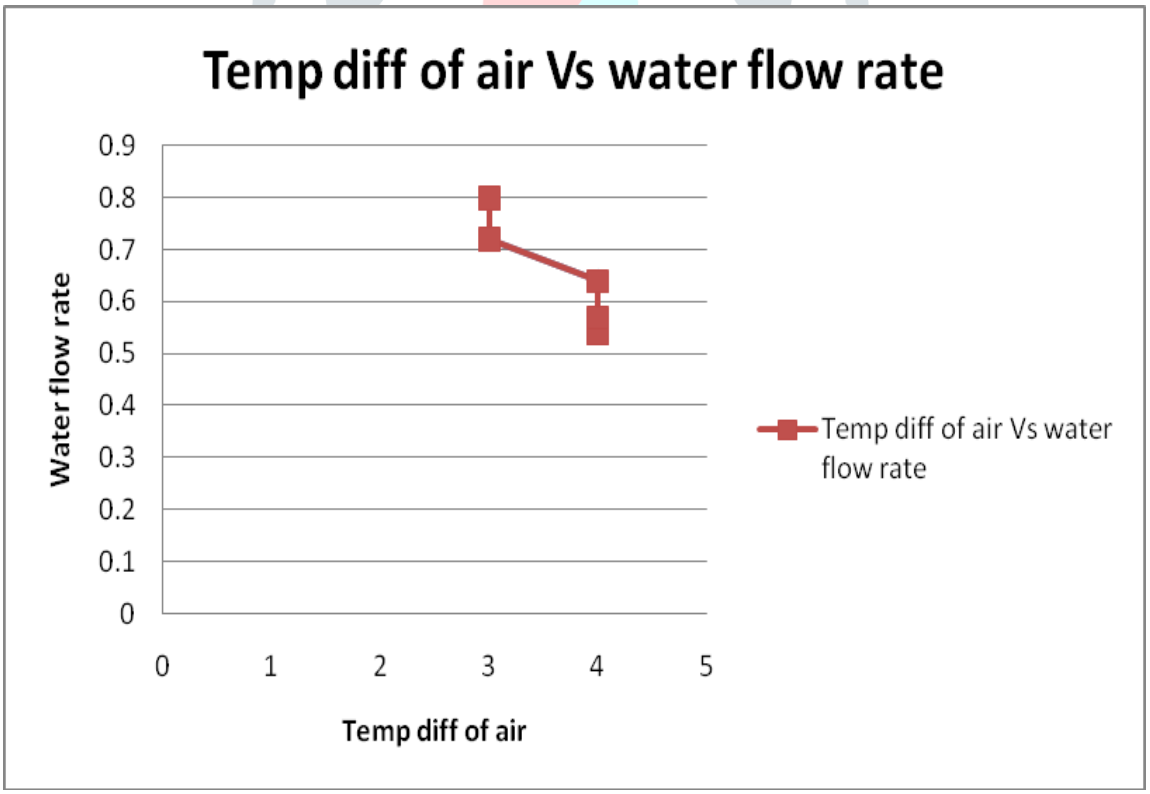
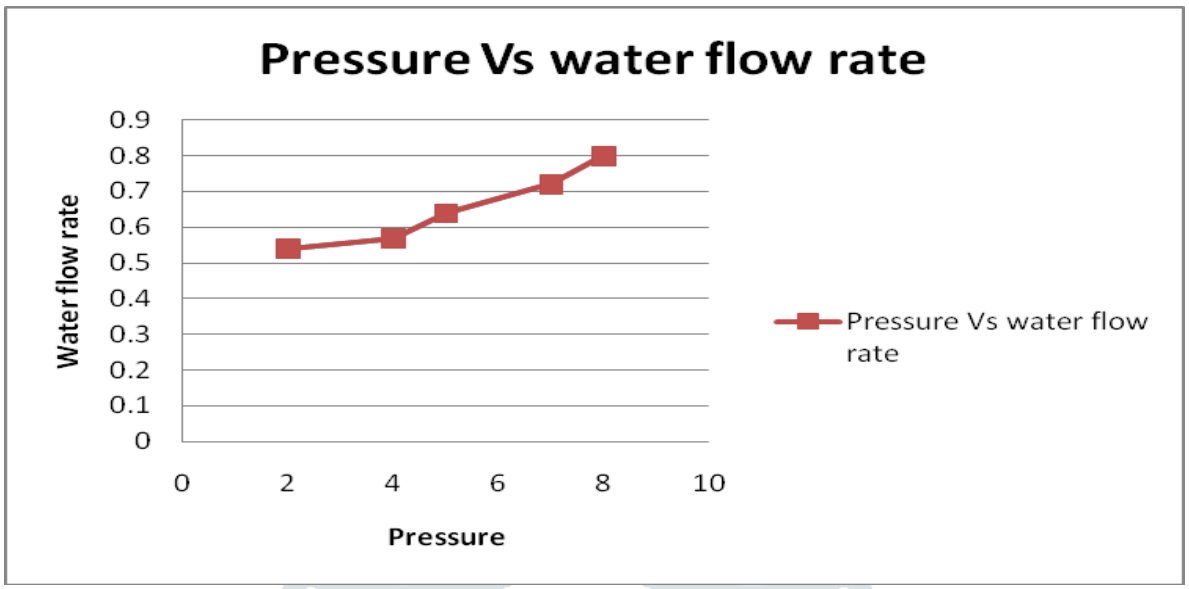


Fig 5.8

5.3.3 PRESSURE Vs WATER FLOW RATE



6. CONCLUSIONS

The present study on the different fans for analysis of heat transfer through air cooled condenser has been performed on the experimental setup. The study was focused on performance of the condenser with different types of fan.
The experiment shows that the condensation increases with the increase of fan speed. As the no. of blades are decreased in the fan the rate of condensation increases. The performance has also been shown in the present work.

7.REFERENCES

1) Heat Exchange Institute, Standards for Steam Surface Condensers, 11th edition, Heat Exchange Institute, Inc Ohio, USA, 2011.
2) Heat and mass transfer Book, By D.S Kumar
3) Process heat transfer by Donald Q. Ken Publisher TMH
4) WWW.thermotch-finnedtubes.com/finnd-tubes.htm
5) Li et al., Sousa A.C.M., Venart J. The numerical and experimental study of a power plant condenser,.Heat Tran.115 (2011) 435–445.
6) Li et al. and Hongtan Liu (2014) Heat Exchangers: Selection, Rating and Thermal Design (2nd ed. CRC Press.
7) Hosseinzadeh et al. (2016): Microchannel air-cooled condenser; Heatcraft Worldwide Refrigeration; April 2016;
8) Condensor, CU Boulder Organic Chemistry Undergraduate Courses, retrieved 2017-4-09
9) Microscale Organic Chemistry Glassware, academic.evergreen.edu, retrieved 2017-04-09
10) Distillation, Wired Chemist, retrieved 2018-04-09
11) "When using the water condenser, which hose connector is water-in and which is water-out?", Practical Lab Tips(chem.ualberta.ca), retrieved 2018-04-09
12) Process Engineering - Design Methods for Reflux Condensers, Chemical Processing, retrieved 2019-04-09
13) Chemical Separations, Purdue University, retrieved 2019-04-09
14) Micro-Scale Distillation, UCLA Chemistry and Biochemistry, retrieved 2020-04-09 Hindelang, Maureen; Palazzolo, Joseph; Robertson, Matthew, "Condensers", Encyclopedia of Chemical Engineering Equipment, University of Michigan, retrieved May 13, 2020