International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 02 | Feb - 2022 ISSN: 2582-3930

DESIGN, FABRICATION AND TESTING OF A WATER COOLER WITH A USE OF HEAT EXCHANGER AS ECONOMIZER

Asst Prof. Nitin Pawar
Mechanical Engineering
Alamuri Ratnamala Institue of Engineering and Technology

Mr. Afghan Shaikh
Mechanical Engineering
Alamuri Ratnamala Institue of Engineering and Technology

Mr. Prajyot Pandit
Mechanical Engineering
Alamuri Ratnamala Institue of Engineering and Technology

Abstract.

Year after year, the cost of electricity rises. The electric energy is produce by different sources like hydroelectric power plant, thermal energy power plant, nuclear power plant, etc. The application uses the electric energy and does the work. All the work done is not utilized, some of work gets wasted. So the ways to avoid the wastage must be found out. There are different ways to recover the energy crisis. In water cooler, water is cooled with the help of electric energy. The majority of the time, varying amounts of cold water are squandered. As a result, electric energy is wasted indirectly. This energy should be conserved. The goal of this project is to design and create a workable economizer model. Heat-exchanger is a device that transfers heat from one medium to another efficiently, with or without connection between the working liquid. This heat-exchanger is used too reduce the amount of energy needed by the water cooler. The literature goal is to pre-cool filtered water using drain water as a cooling fluid. This heat-exchanger is mounted on the outside of the water cooler, requiring no changes to the water cooler's internal configuration. As a result, this Heat Exchanger functions smoothly and efficiently without the need for any external effort or major constructional changes

Keywords*:* Helically coiled tube, Heat transfer coefficient, Coefficient of performance, Shell and tube. cooling system.COP

1.Introduction

Efforts to reduce energy consumption is referred as energy conservation. Energy conservation can be achieved by combining more efficient energy use with lower energy consumption or reduced reliance on traditional energy sources. Individuals and organization who are direct energy consumers choose to conserve energy in order to lower their energy expenditures and improve their financial security. Water coolers which are utilize in colleges for drinking purposes whose work is to reduce the temperature of the water. When a person drinks water, roughly 20 - 25 percent of it is squandered. As a result, cooler's efforts are squandered.

A heat-exchanger is installed in the water cooler to prevent this waste. Economizer is a mechanical tool that efficiently transfers heat in media. Media could be separated by a solid wall, stop them from blend, or they direct contact. Power station , chemical station , gasoline station , and gas station are all examples of space heating, refrigeration and air conditioning. Refiner, fossil fuels & analysis are just a few of the applications. Simply said, a heat-exchanger is a tool that supply thermal energy between too or more fluids, a solid surface & a liquid particles, in thermal contact & at various temperatures. No heated work in heat-exchangers.

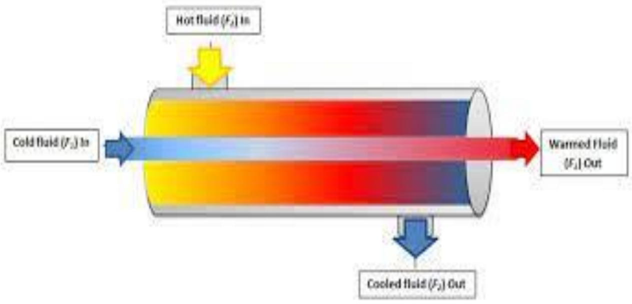


Fig 1: Block diagram of heat-exchanger

In other circumstances, sterilization, pasteurization, fractionation, distillation, concentration, crystallization, or regulation of a process fluid may be the goal. Heat-transfer liquid occurs transiently in split walls in most heat-exchangers. Heat shifting separates the liquid, preventing them from mixing or leaking. Indirect transfer type, or simply regenerators, exchangers in which there is intermittent heat exchange between the hot and cold fluids. Force variable and revolving valve change, liquid discharge from one liquid to other are corresponding in economizer. Shell & tube heat-exchangers, vehicle radiator, condenser, evaporator, pre-heater, & cooling chamber are all e.g. of heat-exchangers. If none of the liquid in the exchanger stage shift to a balanced economizer. The separating wall can be removed if the liquid are immiscible be used as in contact with heat-exchanger

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 02 | Feb - 2022 ISSN: 2582-3930

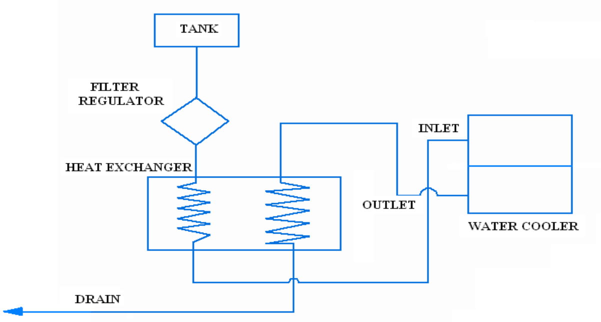


Fig 2: Block diagram of water cooler with heat-exchanger

Every year electricity gets more and more expensive. The electric energy is produced by different sources like hydroelectric power plant, thermal energy power plant, nuclear power plant, etc. The application uses the electric energy and does the work. All the work done is not utilized, some of work gets wasted. So as the ways to avoid the wastage must be found out. There are different ways to recover the energy crisis.

In this research paper inexpensive technique is used to increase the Coefficient of Performance for refrigeration cycle used in the liquefaction of natural gas. With the help of some chemical reactions, It increases the overall COP by 7% and 9%, and also decreases overall work of compressor by decreasing the overall mass flowrate, from the natural gas increase the mass flowrate which required to absorb constant heat. [1] Absorption cooling systems – This paper investigates the issues of increased the fuel prices, energy crises and some environmental issues with refrigeration system this technology issues are tow major problem such as cooling unit is large and low (COP). Some strategies had done successfully to improve the (COP) of absorption refrigerant system. In this research paper conduct a literature review on different technologies upgrade to improve the coefficient (COP) of absorption refrigerating system, these strategies work to design improvement, new working pairs development, sub-component addition and operating condition improvement. [2] In this study the thermal performance is improve by cooling water loop of air conditioning system, researcher had done some experiment to obtained the result, the occurred result compared with conventional system by not using cooling water loop, It increase water mass flow rate with COP and decrease as well and also increase atmospheric temp, the actual result is to allow to improve thermal work of the system and hot tank of water make better performance of energy use-ability.[3] Theoretical Analysis of Hybrid Chiller – In this case Hybrid chiller performance parameter will find out that is main moto, the working parameters are R22 and DMA. R22-refrigerant(chlorodifluoromethane),DMA(dimethylacetamide)absorbent theoretical result obtained through the hybrid chiller system, coefficient of performance (COP) of vapour absorption system improves and the electrical power consumption of vapour compression system is reduced, compared to independent operation of vapour absorption

2.Literature review

cycle in hybrid system absorber heat capacity, the thermal energy is supplied to generator that reduced and heat rejected in condenser. [4] The global warming and conservation of energy are the becoming a severe problem and some energy are the most critical to conservation like electricity use in air conditioning system, the advanced water cooling system with a fuzzy control system is to reduce condenser's noise, place and energy utilization and improve overall performance that make comfort for the users and also saving the power consumption(electricity) and it doesn't create water pollution in tank compared with other air cooled water chiller. The perfect solution for decreasing the water and (power)electricity bill by supersonic mist-cooled chiller. [5] In a half of decade in 2010 to 2015 there was three chillers had been installed manufacture and identified on the test bench. All thermally process for improving quality of chillers had done. All chillers use in direct solar heat of thermal energy from CSP (Concentrated Solar Plant). First chiller was a laboratorial instrumented and cooling average is something 5 kW and second one was little bit similar from first one but version is pre-industrial some cooling average but not fully instrumented and little bit different design. Third one was had cooling capacity of 100kW chiller. In this research described design and technological choice between each chiller and differentiate between chillers experiment is done.[6] It investigates improvement of energy working performance of central-air-conditioning-system through oil free chillers with different controllable speeds. 3 conventional water-cooled centrifugal chillers and placed by 3 oil-free chillers were placed by same size in existing systems data will operate for 1hr for performance evaluation and intervals for over one year before after replacement. The (COP) of oil-free chiller with different speed control took an energy saving of 9.5% in the consumption of whole electricity. The analysis gave a technical efficiency result of 0.6. further COP of system can be better through making the control in temperature of supply chilled water. [7] Paper investigates the issues are rises to shortage the energy with their value grows. HVAC has 50% of energy consumption of the building at hot places and due to humidity condition some energy model code like eQUEST is used to minimize the energy consumption of restaurants, hotels and towers, buildings . As result 10.51% energy will be save through overcome the chillers capacities, all process is made to saving the energy and reduce the trial and error efforts.[8]

3.SOLID MODELING

The fabrication process progresses with the help of solid modelling and engineering drawings created with Solid Works software. Fabrication of all parts designed by the dimension using various types of manufacturing processes is part of the process. Welding, drilling, bending, cutting, and other processes are all part of the manufacturing process. If an error happens during the fabrication process, such as a fabrication error, the process must be modified by returning to the previous step and repeating the process flow until no error occurs, at which point the process can be continued smoothly until the final product is finished. The draught report must then be given to the supervisor for double-checking to see if any errors were made

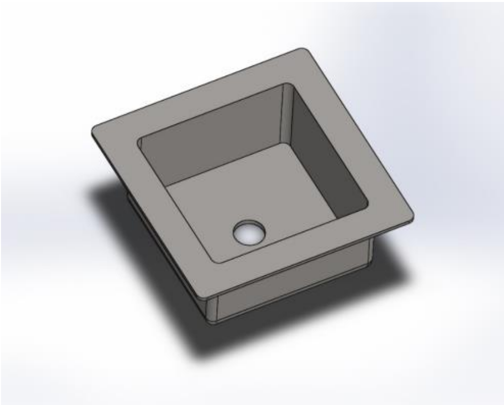


Fig.1:Basin

3.1SOLID MODELING

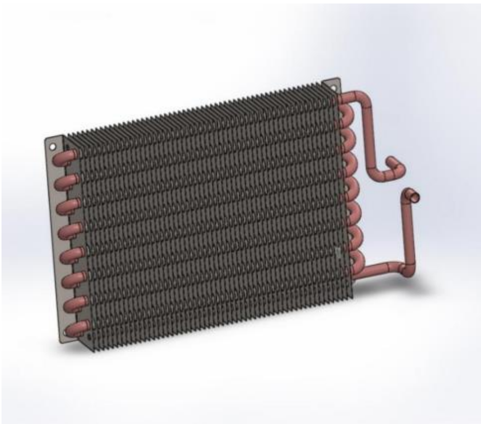


Fig.2: Condenser

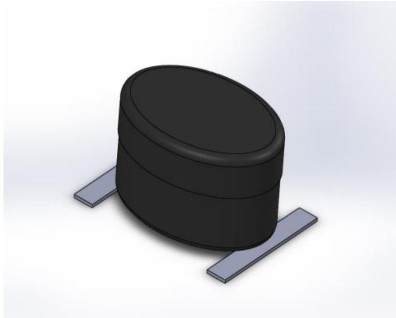


Fig.3: Compresser

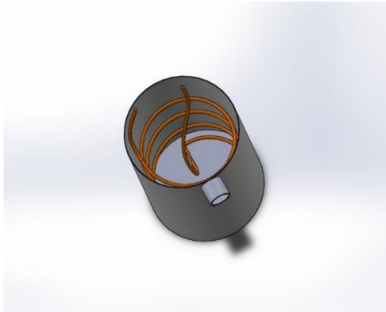


Fig.4: Heat exchanger

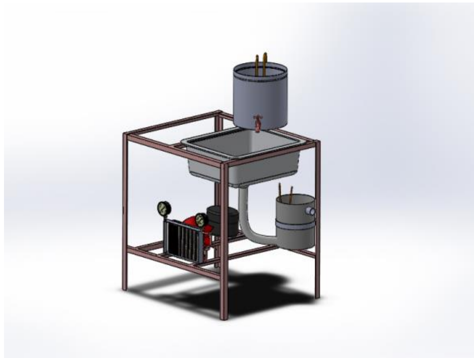


Fig.5:Assembly

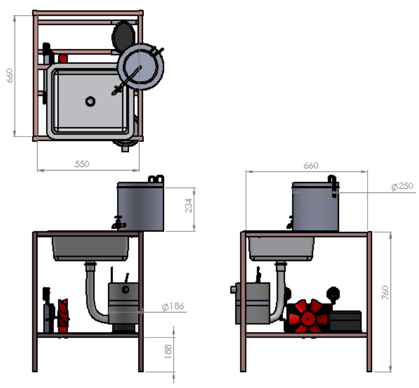


Fig.6: Drafting

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 02 | Feb - 2022 ISSN: 2582-3930

4.RESULTS AND DISCUSSION

4.1.Observation without filling water in heat exchanger

No	Condenser inlet °C	Condenser Outlet °C	Evaporator entry °C	Evaporator exit °C
1	42.1	29.4	10.8	19
2	40.7	31.8	10.5	19.1
3	43	30.5	10	19.2
4	39.2	31.1	10.8	19.4
5	41.2	32	10.7	19.5

No 1.

COEFFICIENT OF PERFORMANCE = (T evaporator exit - T evaporator entry) / (T condenser inlet - T evaporator exit)

COEFFICIENT OF PERFORMANCE = (19 - 10.8) / (42.1 - 19)
= **0.35**

No 2.

COEFFICIENT OF PERFORMANCE = (19.1 - 10.5) / (40.7 - 19.1)
= **0.40**

No 3.

COEFFICIENT OF PERFORMANCE = (19.2 - 10) / (43 - 19.2)
= **0.38**

MEAN COEFFICIENT OF PERFORMANCE = **0.38**

4.2.Observation with new build heat exchanger

No	Condenser inlet °C	Condenser Outlet °C	Evaporator entry °C	Evaporator exit °C
1	36.4	28.4	10	18
2	35.5	29.8	10.8	18.1
3	36	30.5	11.1	20
4	34.3	29	11.8	21.4
5	35.4	28.8	9	17.5

No 1.

COEFFICIENT OF PERFORMANCE = (T evaporator exit - T evaporator entry) / (T condenser inlet - T evaporator exit)

COEFFICIENT OF PERFORMANCE = (18 - 10) / (36.4 - 18)
= **0.43**

No 2.

COEFFICIENT OF PERFORMANCE = (18.1 - 10.8) / (35.5 - 18.1)
= **0.42**

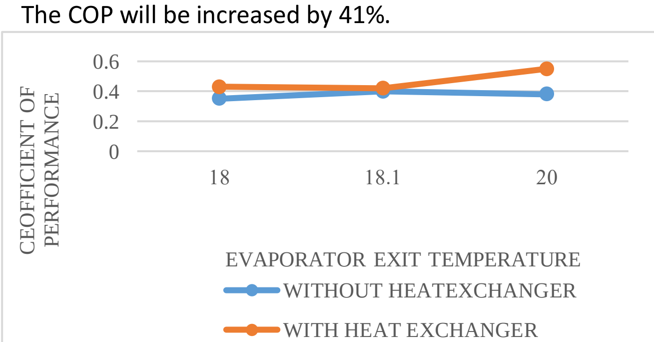
No 3.

COEFFICIENT OF PERFORMANCE = (20 - 11.1) / (36 - 20)
= **0.55**

MEAN COEFFICIENT OF PERFORMANCE = **0.47**

5.GRAPH

Some analysis graph of coefficent of performance generation with and without heat exchanger.As per following calculations we get that, water cooler with economiser is more efficient.The Following graph is the graphical representation of the calculations done above. The COP will be increased by 41%.



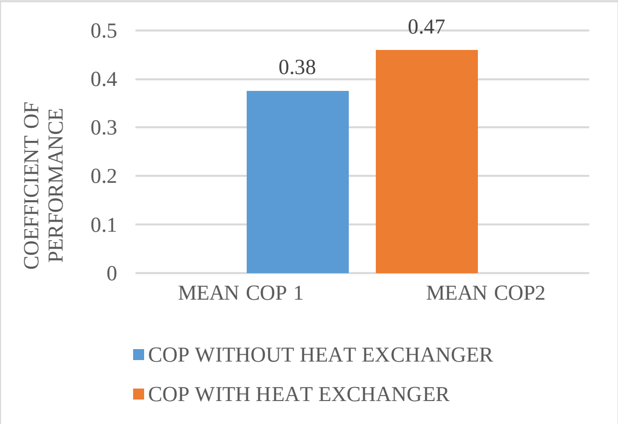


Fig 2.with and without heat exchanger

6.Conclusion

The heat exchanger was created to meet the functional needs. It was discovered that the economizer performed well. The goal of lowering the energy consumption of the water cooler has been achieved. The estimated energy savings after installing a heat exchanger is in the range of 10% to 20%. The readings were taken as is, and based on the calculations, the energy saved after installing the heat exchanger was 15-16 percent. The outcome varies depending on the weather, the amount of water wasted, and other factors. The COP of the entire system was enhanced by 41%. It is the most straightforward way to save electricity while simultaneously achieving a greater cop and lower upfront and ongoing costs.

References

1) W.I. Mazyan b, A. Ahmadi b, H. Ahmed c, M. Hoorfar “Increasing the COP of a refrigeration cycle in natural gas liquefaction process using refrigerant blends of Propane-NH3, Propane-SO2 and Propane-CO2“. Heliyon 6 (2020) e04750

2) Rasoul Nikbakhti a,*, Xiaolin Wang a, Ahmed Kadhim Hussein b, Aghil Iranmanesh, “ Absorption cooling systems – Review of various techniques for energy performance enhancement”. Alexandria Engineering Journal (2020) 59, 707-738

3) A. Siricharoenpanich a, S. Wiriyasart b, R. Prurapark c, P. Naphon, “Effect of cooling water loop on the thermal performance of air conditioning system”. Case Study in Thermal Engineering 15 (2019) 100518

4) Anil Kumbhar, Nitin Gulaneb, Sachin pandure, “Theoretical Analysis of Hybrid Chiller”. Energy Procedia 109 (2017) 487-496

5) Chung- Neng Huang, Ying Han Ye, “Development of a water-mist cooling system: A 12,500 Kcal/h air-cooled chiller”. Energy reports 1 (2015) 123-128

6) Francis boudehenn, Sylvain bonnat. “Development and performances overview of ammonia-water absorption chillers with cooling capacities from 5 to 100 kW”. Energy Procedia 91 (2016) 707-716

7) F.W.YUA, K.T.Chanb, R.K.Y.Sita. “Performance Evaluation of Oil-free Chillers for Building Energy Performance Improvement” Procedia Engineering 121 (2015) 975-983

8) Fujen wanga, Hungmen Ling, Weida tub, “Energy Modeling and Chillers Sizing of HVAC System for a Hotel Building”. Procedia Engineering 121 (2015) 1812-1818