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A Review on Plate fin type condenser of split Air Conditioner

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Abstract: Condenser is the main component of air conditioning system. Copper tube condenser is widely used in the split air conditioning system, but it is costly then alloy plate fin type condenser. The main disadvantage of alloy plate fin type condenser is their leakage and unique maintenance method. We will find to solve the leakage problem of plate fin type heat exchanger by analysis and design of plate fin type heat exchanger.

I. INTRODUCTION

A heat exchanger is a device which is used to transfer heat in form off energy from one fluid to another fluid. The heat transfer rate of heat exchanger or condenser depends on the thermal conductivity of the materials which are used as the wall of condenser. The heat transfer rate also varies depending on the boundary conditions such as adiabatic or insulated wall conditions.

There are various type of condenser used as per their applications and requirement. Air cooled condenser are commonly used in air conditioner. Plate fin exchanger is a type of compact heat exchanger where the heat transfer surface area is enhanced by providing extended metal surface, interfaced between the two fluids and is called the fins. Out of the various compact heat exchangers, plate fin heat exchangers are unique due to their superior construction and performance. They are characterized by high effectiveness, compactness, low weight and moderate cost.

As the name suggests, a plate fin heat exchanger (PFHE) is a type of compact exchanger that consists of a stack of alternate flat plates called parting sheets and corrugated fins brazed together as a block. Streams exchange heat by flowing along the passages made by the fins between the parting sheets. Separating plates Act as the primary heat transfer surfaces and the appendages known as fins Act as the secondary heat transfer surfaces intimately bonded to the primary surfaces. Fins not only form the extended heat transfer surfaces, but also work as structural supports against internal pressure difference. The side bars prevent the fluid from spilling over and mixing with the second fluid or leaking to outside. The fins and side bars are brazed with the parting sheets to ensure good thermal link and to provide mechanical stability. Figure 1 shows an exploded view of two layers of a plate fin heat exchanger. Such layers are arranged together in a monolithic block to form a heat exchanger.

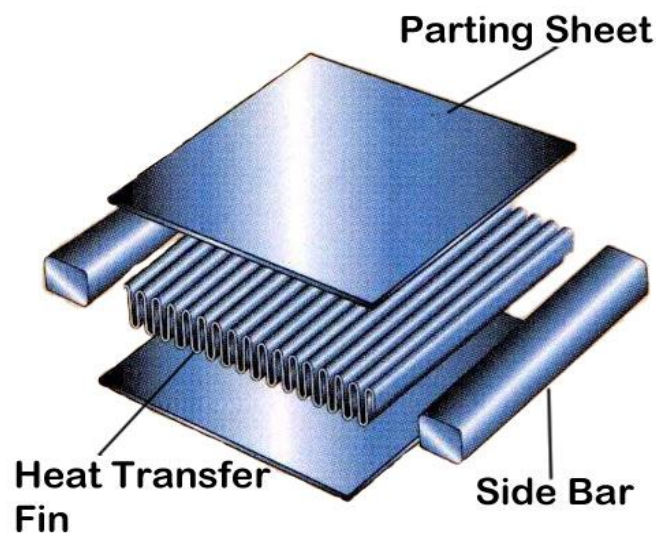


Figure 1 Plate fin Heat Exchanger

Flow arrangement of heat exchanger also impacts on the rate of heat transfer. There are mainly two types of flow arrangement i) Parallel Flow ii) Counter Flow iii) Cross Flow.

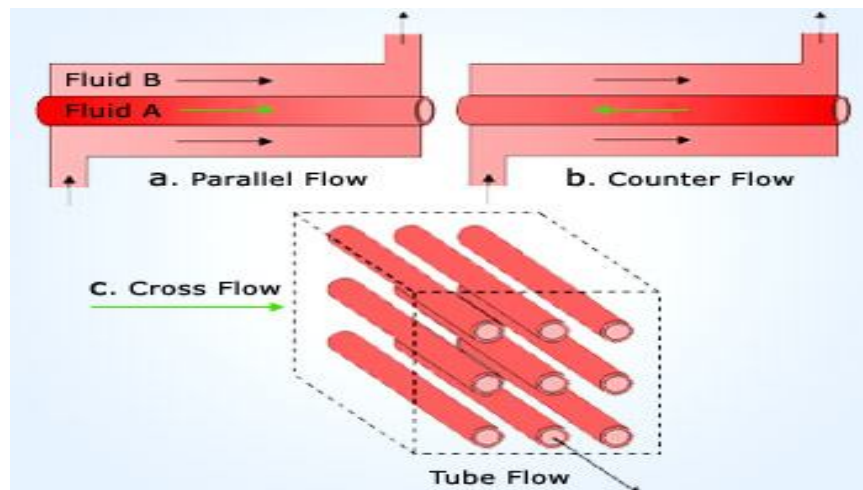


Figure 2 Types of fluid flow

1) Parallel flow: In parallel flow heat exchanger both fluids enter at one end and exit at other end. Heat transfer rate is low compare to counter flow. Temperature at inlet of one fluid is low and other fluid is high as the fluid flow in parallel direction as shown in fig. The heat gets transfer through walls as the fluid flows. Thermal conductivity of heat exchanger is also depending on the walls material so overall parallel flow heat exchanger log mean temperature difference has lower than counterflow.

2) Counter flow: In counter flow heat exchanger one fluid enters at one end and other fluid enters at other end, both fluid passes opposite to each other. As shown in fig both fluids counter to each other. In this heat exchanger heat transfer rate is very more compare to other flow heat exchanger. Counter flow is the most common type of liquid-liquid heat exchanger, because it is the most efficient.

3) Cross flow: In a cross flow heat exchanger, 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. If high effectiveness is not necessary, if the two streams have widely differing volume flow rates, or if either one or both streams are nearly isothermal (as in single component condensing or boiling), the cross flow arrangement is preferred. Typical applications include automobile radiators and some aircraft heat exchangers.

II. LITERATURE REVIEW

B. Sreelakshmi conducted an experiment study for performance analysis of finned tube air cooled condensing unit of split air conditioner. In this study, condenser model was developed in Pro Engineer and COSMOSWorks software is used for thermal analysis. The effects of changing the fin material and fin thickness on condenser performance have been investigated. By performing this study author get analysis 1. Considering different factors for a condenser, such as heat transfer, density, etc., Aluminum alloy 1100 is found to be the best fin material. 2. The results show that the heat transfer decreases with an increased fin spacing. These differences are caused by decreased fin wake interactions with increased fin spacing. [1] N. V. Sali, Kirti N. Thakare conducted an experimental study for Thermal analysis of air cooled condenser of chiller by replacing copper to aluminium tubes. The mathematical and experimental study has been carried out to design the air cooled condenser of a chiller by replacing Cu. The main objective of this study is cost reduction with same performance which is based on performance parameter and economic parameters. The main performance parameters are overall heat transfer coefficient, and it seems that the air side coefficient is more dominant than the refrigerant side coefficient, therefore the overall heat transfer coefficient which is summation of air side and refrigerant side performance coefficient is approximate same by replacing Cu to Al tubes. The theoretical investigation promises the cost benefit of air cooled condenser is up to 24% and other benefits for stationary refrigeration and air-conditioning systems which follow from the use of aluminum heat exchanger are lower material costs and weight, better resistance against environmental influences, and minimized recycling. [2] Mallikarjun, Anandkumar S Malipatil had done CFD analysis of air cooled condenser by using copper tubes and aluminum fins. The materials considered for tube is copper and for fins are Aluminum alloys 1100, 6063 and Magnesium alloy for different refrigerants HCFC and 404R. CFD analysis is done at different velocities. Theoretical calculations are done to determine heat transfer rate. Heat transfer analysis is done on the condenser to evaluate the better design and material. Analysis is done in Ansys. The analysis is done to verify the heat transfer rate, temperature distribution. The better material for fin and better refrigerant are analyzed using heat transfer analysis. By observing the thermal analysis results, using fin material

Aluminum alloy 1100, thermal flux is more than other two materials. So by using Aluminum alloy 1100, the heat transfer rate increases. And also by taking refrigerant R404 is better. Thermal flux is also calculated theoretically, by observing the results, using fin material Aluminum alloy 1100 and refrigerant R404 has more heat transfer rate. [3] NadadariBheemesh, N. Venkateswarlu started a research on Design and heat transfer analysis of AC condenser for different materials. The main objective is to design, develop and utilize the high-efficient heat transfer of an AC condenser. In this research The assessment is carried out on an air-cooled finned-tube condenser of a vapour compression cycle for air conditioning system. Heat transfer analysis is done on the condenser to evaluate the material and refrigerant. The materials considered for tubes are Copper and Aluminum alloy 1100 and for fins are 1050 and 1100. The refrigerants varied are R12, R 22 and R 134. From the analysis results, the heat transfer rate is more when refrigerant R22 is used since heat flux is more. When compared the results for tube material between Copper and Aluminum, using Copper is better. But the disadvantage of using Copper is its weight, so aluminum alloy 1100 can be an alternative. When compared the results for fin material between Aluminum alloy 1100 and 1050, using Aluminum alloy 1050 is better. Heat transfer analysis is done on the condenser to evaluate the material and refrigerant. The materials considered for tubes are Copper and Aluminum alloy 1100 and for fins are 1050 and 1100. But the disadvantage of using Copper is its weight, so aluminum alloy 1100 can be an alternative. When compared the results for fin material between Aluminum alloy 1100 and 1050, using Aluminum alloy 1050 is better. [4] Jan Olsson, Avesta Sheffield study on the condenser tubes of stainless steel [Highly Alloyed 65 SMO]. Copper base alloys, both brass and copper nickel, have high coefficients of thermal conductivity while some other materials, e.g. titanium and stainless steel, are inferior in this respect. The high yield stress of 654 SMO is combined with a high elongation before rupture which implies good formability, almost on the same level as for a conventional austenitic grade such as 316L. They study that 654 SMO is very good and able to cope with the hostile environments existing inside condenser tubes, erosion resistance of 654 SMO can be an advantage. There should be no concern about the heat transfer characteristics. The use of a highly alloyed stainless steel like 654 SMO will have no negative impact on neither water as food, nor on the environment. [5] Madhu Jhariya, P.K. Jhinge and R.C. Gupta done an experimental performance of a window air conditioner with two different types of condensers, single channel and multi-channel condenser. The air-conditioner is a 1 TR unit designed for R-22. The performance of the air-conditioner with R-410A is compared with the baseline performance with R-22. The performance parameters considered are cooling capacity, coefficient of performance, energy consumption, and compressor work done. Test results shows that for R-22 the COP of multi-channel condenser is 6.6% efficient than the single channel condenser. The cooling capacity of multi-channel condenser is 38.4 % higher than the single channel condenser. From the experimental study to evaluate the influences of condenser on 1TR window air conditioner with refrigerant R-22 and R-410A. The following conclusions are drawn: a) For single channel condenser, the cooling capacities, condenser heat transfer rates and EERs decrease with increasing outdoor temperatures. b) The same trends are for the system with multi-channel condenser, the COPs and mass flow rates increase with increasing outdoor temperatures. c) The coefficient of performance of multi-channel condenser is 7.1% efficient than the single channel condenser. [6]

III. CONCLUSION

Plate fin type heat exchanger is a device to transfer the heat from one medium to another. We are analyzing the plate fin aluminium condenser used in split Air conditioner. In our project we are using plate fin type aluminium condenser. In this condenser we are analyzing the condenser using Ansys software and find some new results using different materials to get better result. Main problem of aluminium condenser is gas leakage, gas leakage problems occurs mostly in this material of condenser. We will try solve this problem by using different material added in the condenser in the design software.

By using aluminium and alloy condenser the cost of split air conditioner decrease. Its operating cost also decrease by increase its heat transfer rate of the condenser.

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