

# Performance of Air Cooled Condenser in various Conditions: A Review

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**Abstract-** Air Cooled condensers were first presented in US control industry in mid1970's, however just during last 10-15 a long time number of establishments significantly expanded to a great extent because of developing consideration being paid to natural wellbeing. Moreover, developing interest for water for both household and modern use has acquired an expanded intrigue utilization of Air Cooled condensers. This is an audit paper which concentrates the presentation of Air-cooled condenser under different working conditions it is discovered that there is corruption in execution of air cooled condenser under high encompassing temperatures and breezy conditions. The warmth dismissal pace of ACC likewise relies upon surface state of balances and accordingly its exhibition is decreased because of outside fouling of finned tubes because of climate conditions and by inner fouling from condensate (Ammonia erosion). A Hybrid (dry/wet) dephlegmator accomplishes significant improvement in execution when surrounding temperatures are high. Additionally concealing of condensers is accomplished for cooling units to alleviate the unfavorable impact of high surrounding temperatures because of sun powered radiation. Presently a day's breeze dividers are utilized to diminish the impact of high wind speed .second choice is to build the fan speed Fin cleaning assumes a significant job in warmth dismissal. Outside cleaning improves air side warmth move coefficient. So as to improve the exhibition of ACC Flat cylinders slanted at some edge to level can likewise be utilized instead of customary round level cylinders with the goal that an improvement in warmth move rate happens.

**Keywords:** Air cooled condensers, Ambient temperatures, Fin cleaning, Heat move, Execution investigation.

## I. INTRODUCTION

A condenser is a warmth move gadget or unit used to gather a substance from its vaporous to its fluid state, commonly by cooling it. In doing as such, the dormant warmth is surrendered by the substance, and will move to the condenser coolant. Condensers are normally heat exchangers which have different structures and come in numerous sizes extending from rather little (hand-held) to enormous modern scale units utilized in plant forms. For instance, a fridge utilizes a Condenser to get free of warmth removed from the inside of the unit to the outside air. Condensers are utilized in cooling, mechanical concoction forms .Such as refining, steam power plants and other warmth trade frameworks. Utilization of cooling water or encompassing air as the coolant is basic in numerous condensers. The fundamental utilization of a condenser is to get depleted steam from a steam motor or turbine and gather the steam. The advantage being that the vitality which would be depleted to the environment is used .A steam condenser by and large consolidates the steam to a weight essentially beneath barometrical. This enables the turbine or motor to accomplish more work. The condenser likewise changes over the release steam back to feed water which is come back to the steam generator or evaporator. In the condenser the inert warmth of buildup is directed to the cooling medium moving through the cooling tubes.

## II. CONDENSERS USED IN POWERPLANT

There are basically two types of condenser used in thermal power plant which are steam condenser and air cooled condenser;

### 1. Steam Condenser or Water Cooled Condenser

It is a gadget or a machine wherein steam gathers and warmth discharged by steam is consumed by water. A steam condenser is a gadget which gathers the steam at the fumes of turbine. It serves two significant capacities. Right off the bat, it makes an extremely low weight at the fumes of turbine, in this way allowing extension of the steam in the prime mover to exceptionally low weight. This aides changing over warmth vitality of steam into mechanical vitality in the prime mover. Furthermore, the dense steam can be utilized as feed water to the heater.

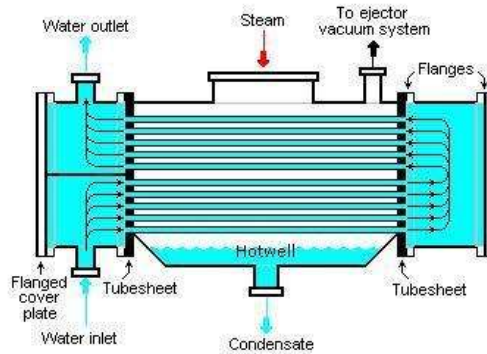


Figure 1. Water Cooled Condenser

There are two chief kinds of Steam Condensers a) Jet condensers b). Surface condenser

A) *JET condensers:*

In a stream condenser, cooling water and depleted steam are as one. In this manner, the temperature of cooling water and condensate is a similar when leaving the condenser. Focal points of this kind of condenser are low introductory cost, less stream region required, less cooling water required and low support charges. Anyway its disservice is condensate is squandered and high power is required for siphoning water.

B) *Surface condenser:*

In a surface condenser, there is no immediate contact between cooling water and depleted steam. It comprises of a bank of even cylinders encased in a cast iron shell. The cooling water moves through the cylinders and depleted steam over the outside of the cylinders. The steam surrenders its warmth to water and is itself consolidated. Favorable position of this kind of condenser are : condensate can be utilized as feed water, less siphoning force required and making of better vacuum at the turbine exhaust. In any case, hindrance of this kind of condenser are high introductory expense, requires huge floor region and high upkeep charges. The surface condenser is utilized for most of steam motor and steam turbine applications.

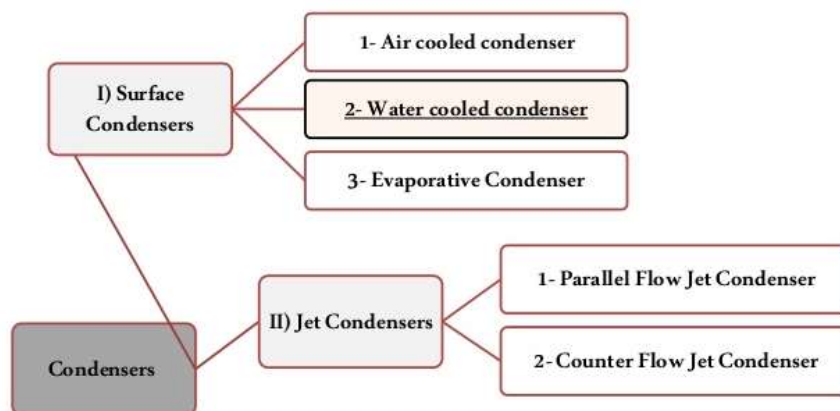


Figure 2. Classification of Water Cooled Condenser

## 2. Air Cooled Condenser

An Air cooled condenser, is essentially a weight vessel which cools a flowing liquid inside finned tubes by driving surrounding air over the outside of the cylinders. A typical case of an Air cooled condenser is vehicle radiator Air cooled heat exchangers are utilized for two essential reasons.

- I. They increment plant effectiveness.
- II. They are a decent arrangement when contrasted with cooling towers and shell and cylinder heat exchangers since they don't require an assistant water supply (water lost because of float and vanishing, in addition to no water treatment synthetic compounds are required).

An air-cooled heat exchanger can be as little as your vehicle radiator or enormous enough to cover a few sections of land of land, just like the case on air coolers for huge power plants the air-cooled heat exchangers are for the most part utilized when the plant area and the encompassing Conditions don't permit a simple and monetary utilization of other cooling frameworks.

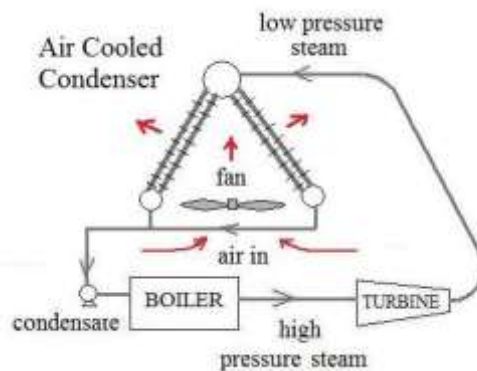


Figure 3. Basic Air Cooled Condenser cycle

The most obvious favorable circumstances of air-cooled Condensers are:

- a) No issue emerging from warm and substance contamination of cooling liquids
- b) Flexibility for any plant area and plot plan course of action since hardware requiring cooling need not be almost a stock of cooling water.
- c) Reduction of support costs
- d) Easy establishment
- e) Lower natural effect than water cooled condenser because of the disposal of a helper water supply bringing about water sparing
- f) No utilization of water treatment synthetic compounds and no requirement for fire insurance framework.

Air-cooled finned-tube condensers are generally utilized in refrigeration and cooling applications. For a similar measure of warmth move, the activity of air cooled condensers is progressively financial as contrasted and water cooled condensers regularly air-cooled condensers are of the round cylinder and balance type. To improve the presentation of air-cooled condensers numerous strategies can be accomplished, for example, improvements on internal pipe surface, changing the cylinder geometry from round to level shape and outside blades.

## III. FOULING TENDENCIES OF AIR COOLED CONDENSER

The outer surfaces of the finned cylinders on air-cooled condensers are exceptionally inclined to fouling from dust, dust, bugs, leaves, plastic packs, winged animal bodies, and so on. Not exclusively is the wind stream influenced yet in addition the warmth move coefficient, the decay in execution expanding unit working expenses. In serious cases, fouling can likewise constrain the power age limit of the turbo generator. To improve the warmth evacuation limit of an air-cooled condenser under states of high surrounding air temperature, administrators will here and there shower water on the warmth exchanger to diminish surface temperature. Lamentably, contingent upon the nature of water utilized, this occasionally prompts new scale arrangement on the cylinder balances and, once more, lessens the warmth move rate if the stores are permitted to gather.

#### IV. CLEANING TECHNIQUES FOR AIR COOLED CONDENSER

The three fundamental strategies for cleaning the outside surfaces of air cooled condensers are as Follows: 1. Fire hose 2. High weight Hand spear 3.Semi-Automated cleaning Machine

- A) *Fire hose* - Even however the volume of water expended high, the washing impact of Fire hose is low because of low weight included. The excited surfaces of cylinders and Fins are not harmed by this technique the procedure is Labor and time serious, and just a little improvement in execution regardless of whether surface is by all accounts optically spotless. The explanation is just a part of fouling material is washed off and rest is squeezed between balance tubes and can't be washed off by this strategy. Once more, the plant must be removed from administration and framework rose all together that cleaning can be performed.
  
- B) *High weight Hand spear*- This technique offers low water utilization and high water weight sadly the later can make the aroused surfaces become harmed or Fins to be snapped off. Similarly as with the utilization of fire hose this strategy offers a little improvement in execution and once the fouling material has been packed, It prevents warmth move and deters wind current. Lamentably, so as to perform cleaning the plant must be removed from administration and platform raised.
  
- C) *Computerized Cleaning Machine* - The Automated cleaning Machine utilizes a noteworthy volume of water, yet at weight that while taking into account compelling surface cleaning abstains from harming aroused surfaces and blades .A significant bit of leeway of mechanized cleaning technique is that cleaning can be performed during activity while the unit is as yet on the web.

#### V. LITERATURE SURVEY

[1] A Study was performed on Performance Characteristics of an Air-Cooled Condenser under Ambient Conditions in December 2011. In this investigation impacts of wind current example just as encompassing conditions were examined. Sadly ACC turns out to be less compelling under high encompassing temperature and blustery conditions. Blade cleaning assumes an indispensable job in warmth dismissal. Outside cleaning improves air side warmth move coefficient. Encompassing conditions influence the steam temperature and warmth dismissal rate. It is seen that ascent in wind speed diminishes warm adequacy of ACC up to extensive level. Surrounding temperature not just influences execution of ACC simultaneously turbine back weight additionally increments with ascend in encompassing temperature. Skirts are compelling answer for diminish the impact of wind on volumetric viability. Sight-seeing recirculation increments with wind speed. Presently a day's breeze dividers are utilized to decrease this impact. Subsequent choice is to build fan speed. It counters effects on electrical power utilization.[2] A study was performed to evaluate the performance characteristics of a power plant incorporating a steam turbine and a direct air-cooled dry/wet condenser operating at different ambient temperatures. The proposed cooling system uses existing A-frame air-cooled condenser (ACC) technology and through the introduction of a hybrid (dry/wet) dephlegmator achieves measurable enhancement in cooling performance when ambient temperatures are high. [3] In this study they found that air-conditioning system with air cooled condensers, the condensing unit has to be kept in open for easy access to outdoor air in order to efficiently dissipate heat, During Daytime the solar radiation falling on the surface of the condenser and high ambient temperature can be detrimental for the energy performance. They studied the effectiveness of shading the condensing unit to mitigate the adverse effect of high ambient temperatures due to solar radiation .and analyzed that the theoretical increase in COP due to shading is found to be within 2.5%.

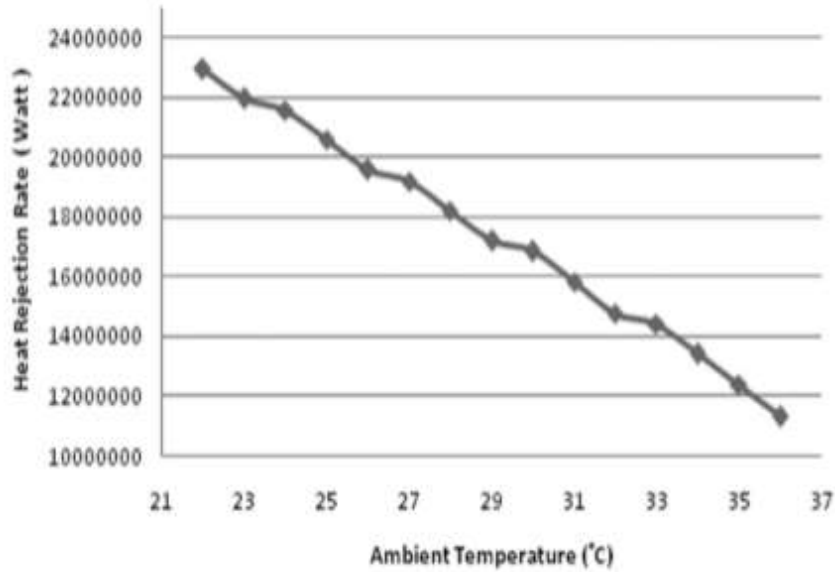


Figure 4. Heat Rejection for various Ambient Temperatures. (Courtesy: Nirma Institute NUiCONE – 2011)

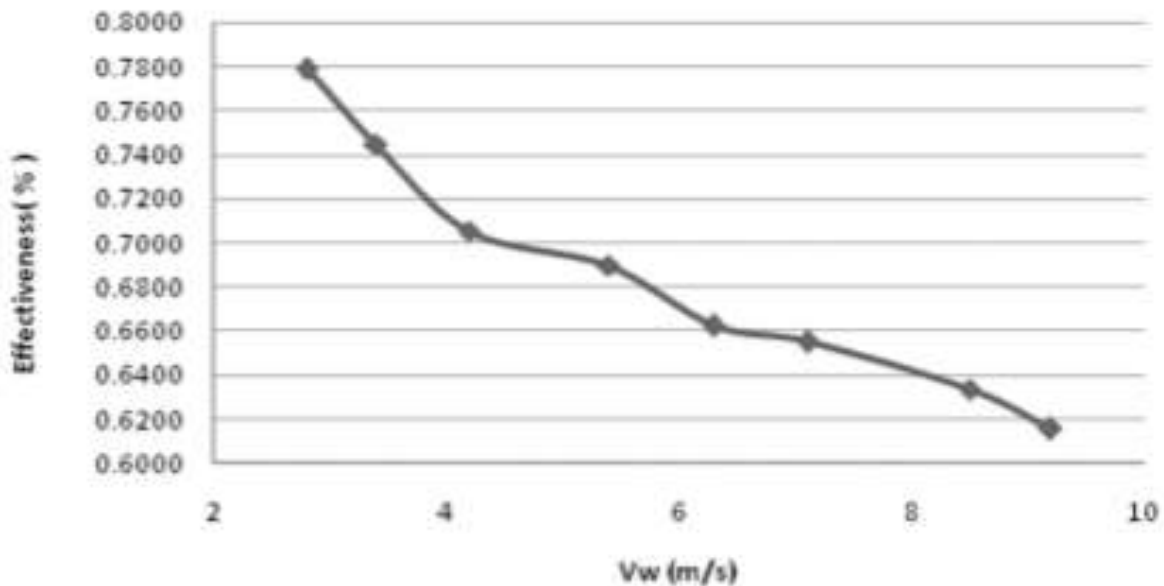


Figure 5. Effectiveness at different Wind Velocities (Courtesy: Nirma Institute NUiCONE – 2011)

[4] Heat transfer by convection in air cooled condensers is studied and improved in this work. In order to enhance the performance of air cooled condensers, it is important to take into consideration both of condensation inside condenser tubes and convection outside, where the enhancement in convection side is the dominant one. Aluminum extruded micro-channel flat tubes improve the performance of condensation more than conventional circular tubes but still has potential for air side improving. So the enhancement of convective heat transfer in air side is achieved in this study by inclination of the flat tubes by a certain angle with respect to horizontal in two cases.

## VI. CONCLUSION

The primary focus of this study is to evaluate the performance of Air-cooled condenser under various conditions. The performances of air-cooled condenser decreases with increase in ambient temperatures and high wind conditions. Hybrid (dry/wet) dephlegmator achieves measurable enhancement in cooling performance when ambient temperatures are high. Wind-walls are used to reduce the effect of wind .fan speed can also be increased. Changing the Shading the ACC of air-conditioned unit helps to reduce the high ambient temperature due to solar radiation. Shape of finned tubes from circular to flat and adjusting their inclination also helps in increasing heat transfer rate. Various techniques are also used to clean the tubes to increase heat transfer rate. Generally, ACC is really useful where ambient temperature no longer raising a whole lot, in particular at seaside areas. More than that ambient temperature also results on turbine again stress which could lessen the output strength. In each those instances, ambient temperature effect is full-size. After ambient temperature wind pace is the secondary parameter that influences on ACC performance. As the wind speed will increase effectiveness (thermal and volumetric) decreases and warm air recirculation will increase. Hot air recirculation is generally discovered in such a lot of flowers. To minimize fan rotational speed to be increased. This is not the answer due to the fact electrical strength intake with the aid of the fan will increase. The premier solution is the wind wall on the perimeters of the radiator. Various techniques for cleaning are followed to growth the warmth transfer price. As the cleaning progresses for numerous heat switch coefficients (airside) improves.

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