iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** IV **Month of publication:** April 2017

DOI: http://doi.org/10.22214/ijraset.2017.4056

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Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

A Review on Tube Failure Analysing and Improving Condenser Performance

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Abstract: ***The thermal power plants are used to generate power and the design is based on required conditions, but actually inlet conditions are not as per the designed conditions. In realistic conditions, a limitation such as diminish or boost in heat pace and produced power during power plants installation happens. Due to these conditions, the designed heat rate and power are rarely achieved. Variations in the power output from plant are always a matter of disputes. Dissimilar circumstances of condenser pressure, run rate of water all the way through the condenser, heat differences are the restraints of heat rate and power. The action of the condenser unit can be estimated by the location dimension and work out information gathering which point out that if working circumstances disagree, then power production and heat rate also differ. We can get rid of or decrease the minimum or overall scaling, there is a rising in performance of the condenser by using a variety of tube cleaning techniques.***
Keywords*: Condenser, Temperature, Pressure, Heat transfer, Power Plant.*

I. INTRODUCTION

In thermal power stations, power is produced by a heat engine that transforms thermal energy, often from combustion of a fuel, into a rotational energy. Not all thermal energy can be transformed into mechanical power and there is constantly heat thrashing to the surroundings If the heat loss is employed in an efficient way, it will be useful to the environment.

Condenser is a closed vessel in which steam is condensed by abstracting the heat and where the pressure is maintained below atmosphere pressure. The major function of steam condenser in turbine is to uphold a little back pressure on the wear out side of the steam turbine. Entropy is defined as the more ways the system can be arranged The higher the entropy, the more the structure is disordered. The enthalpy of formation is defined as the energy, in the form of heat, given off or absorbed during a chemical reaction under the most stable conditions for the reaction to occur from pure elements.

A boiler is a clogged vessel in which water or other liquid is heated. The frenzied fluid leaves the boiler to employ in a variety of process or heating applications, together with water heating, inner heating, power generation with the use of boiler, cookery and sanitation.

II. EQUIPMENTS USED

A. Condenser

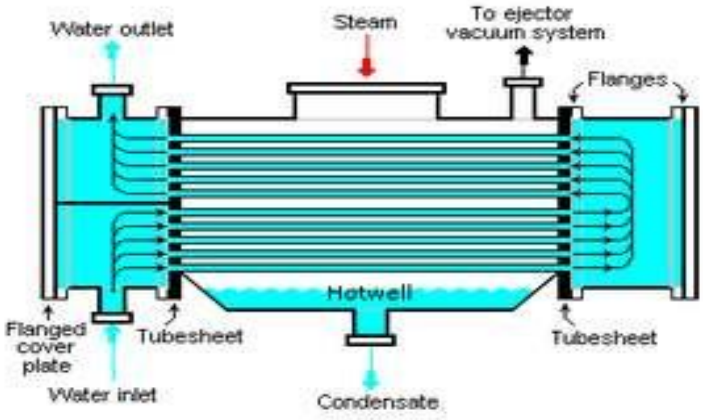

Fig 2.1 Condenser

Volume 5 Issue IV, April 2017
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These condensers are heat exchanger which converts steam from its gaseous to its liquid state at a pressure below atmospheric pressure where cooling water is short supply; an air-cooled condenser is often used. An air-cooled condenser is though significantly more unrestrained and cannot attain as low as a steam turbine.

Condenser is a type of heat exchanger in which hot fluid becomes cold fluid. Surface condenser is a commonly use term for a water –cooled shell and tube heat exchanger installed on the tire out steam from a steam turbine in thermal power stations.

B. Types of Condenser

1) *Water Cooled Condenser:* A water-cooled condenser is a heat exchanger that removes heat from refrigerant vapour and transfers it to the water running through it. The cooled vapour condensed on the exterior of a tube does this process. In this process, the vapour condenses and gives up high temperature to the water inside the tube.
2) *Air Cooled Condenser:* An Air Cooled Condenser (ACC) is a direct dry cooling system where the steam is condensed inside air-cooled finned tubes.
3) *Evaporative Condenser:* It is a heat exchanger in which a refrigerant is chilled by a mixture of air and water.

III. PROBLEM IDENTIFICATION

A. Scale Formation

Scaling refers to accumulation of unwanted material on solid surface, most often in an aquatic environment .the term scale usually refer to an intimate mixture of sparingly soluble mineral salts. The formation of calcium carbonate, calcium phosphate, silica salts, & calcium sulphide & corrosion products depend on the PH & the concentration of impurities in it. Other terms used in the literature to describe fouling include deposit formation, encrustation, crud ding, deposition, scaling, scale formation, slagging &sludge formation.

Fig. 3.1 Level formation

1) *Reasons of Formation of Scale:*

a) Decay or polymerization of natural substance on heating are
b) Accretion of particles, particularly colloidal particles on a surface
c) Precipitation fouling, as aggregation of solid salts oxides and hydroxides for water.
d) Corrosion fouling i.e, in –situ growth of corrosion deposit ,for example magnetite on carbon steel surface

Bio fouling, like settlements of bacteria and algae.

2) *Consequence of Scaling:*

a) Reduce thermal efficiency.
b) Decrease heat flux.
c) Increase temperatures on the hot side
d) Reduce temperatures on the frosty side.
e) Induces under deposit corrosion
f) Decrease flow and boost pressure drop.
g) Amplify upward pressure
h) Enlarge energy expenses.
i) Enhance flow velocity

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IV. METHODOLOGY

A. Types of Cleaning Method

There are two types of cleaning method

1) Online method
2) Ball cleaning method
3) Offline method
4) Bullet cleaning method
5) Shell side cleaning method
6) Helium detection method

B. Online Method

When a condenser tubes are running condtion that time cleaning process will be going is called as online method.

1) *Ball Cleaning Method:* The patented process uses sponge rubber balls which are injected into the cooling water flow before it enters into the condenser. The diameter of cleaning balls is only slightly bigger than the normal diameter of the condenser tubing. Due to their elasticity they generate a contact pressure on their way through the condenser tube by which fouling is removed from the inner tube walls. At the condenser outlet a strainer is installed in the connecting pipe which separates the balls from the water flow and feeds them into a DN 80 pipes. Since there, the balls are forced back to the opening pipe by a impeller pump via a DN80pipes.To inject the balls into the cycle, a pressure vessel with data cable cover is installed downstream of the pump.

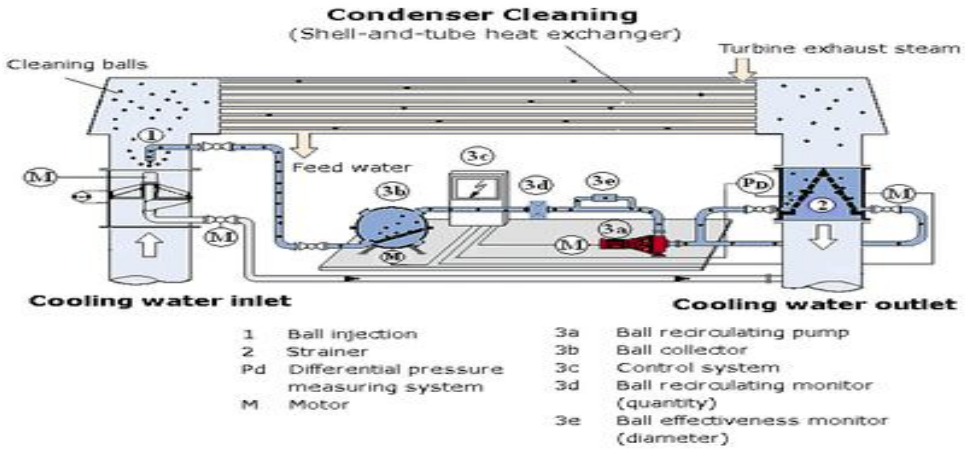

Fig. 4.1 Ball Cleaning Method

At open flap, the balls can pass with closed flap they remain in the collector and can be replenished or exchanged. The process work continuously and tubes remain free of mud, algae, bacteria, & scaling. The process of the system is watched by sight glass and electronic gauging instruments. The screen surfaces are arranged on shafts with pivoted bearings can be turned on demand to have fouling removed by the water flow. In this process the balls are caught in the collector.

The final diameters of the screens have been adjusted to respond to the development in power station technology and are produced in from nominal diameter 150 mm to 3700 mm. the cleaning ball diameter ranges from 14 to 30 mm and filling one collector normally require several hundred of them.

C. Offline Method

1) *Bullet Cleaning Method:* Spring loaded tube cleaners are shot through fouled condenser tubes using specially designed water guns at 10to15 KG/CM2 pressure .The bullets moving through the tube from one end to other scrap of the deposits' and corrosion scales. Water from the gun flushes out of the scrap deposits results in a cleaning side of the surface for the tube, ideal for the good heat transfer tube cleaners which exit at the another end of the condenser are collected ,cleaned used again normally a bullet can be reused 10 to15 times.

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2) *Shell Side Cleaning Method:* The cleaning of surface condenser pipe with non ionic eco-friendly solution will improve the performance of the system. This cleaning approach helps to remove scale from the condenser tube at shell side and hence heat transfer will get improved.

Fig 4.2 Bullet cleaning

3) *Helium Detection Method:* Air in leakage is one of the worst obstacles of the condenser vacuum system, which under the performance of the equipment. Air in leakage results in blanketing tube surface the steam side there by reducing the heat transfer efficiency as air is bad conductor of the heat.

The performance of condenser tube analysed by the efficiency parameters.

It is defined as ratio of difference between the outlet and inlet temperature of cooling water to the difference between the temperature corresponding to the vacuum in the condenser and the inlet temperature of cooling water.

Condenser efficiency = (TI/T2-T3)

Where:

T1= Rise in temperature of cooling water
T2= Temperature corresponding to vacuum
T3= Inlet temperature of cooling water

V. CONCLUSION

Thus we have done a complete study on the condenser and its auxiliaries; It shows that the condenser is one of the main deciding factors of turbine efficiency. For this analysis surface condenser should be operated at full capacity of a 210MW to get maximum efficiency and high performance. The deviation may occur due to variations in the input parameters due to weather and other working conditions. Hence this analysis is an appropriate matter for condition monitoring. The cooling water inlet temperature should be maintained below 30°C to get better performance. The speed of water in the course of the tube increases the heat transmission rate up to 27000m3/hr.

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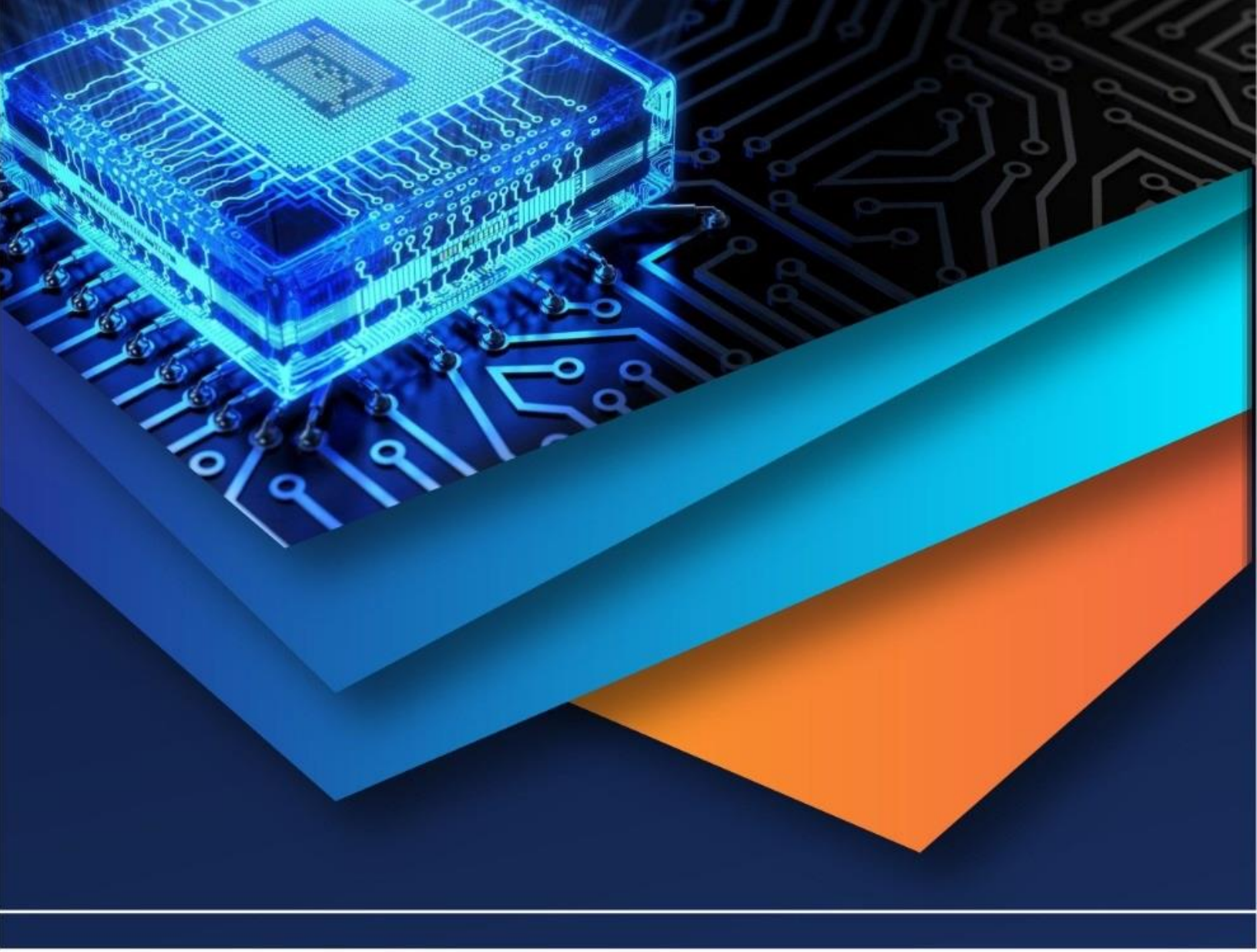

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