ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 9, Issue 6, June 2022.

Energy Analysis and Evolutionary Of Steam Boilers to Blow Down Heat Recovery Process

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Abstract: The objective of this Paper is to blow down the salt deposition on the fire tube boiler line and to control the scale deposition on the inner layers of the boiler. so we have planned to provide to indicate water parameter (PPM) level by using a blowdown controller valve before the inlet to avoid the scale formation on the surface area by using the TDS sensor (total dissolved solids).To control the scale formation and to increase the boiler efficiency as well as its lifetime and to avoid breakdown maintenance period water treatment has to be done before it fed into the boiler to avoid corrosion, scale formation, priming, foaming, salt deposition on the inner layer of the boiler tubes which were the major barrier to the boiler.

Keywords: Boiler,TDS Sensor,Valve.

I. INTRODUCTION

This The boiler is a closed vessel into which water is heated until the water is converted into steam at the required pressure. This is the most basic definition of a boiler. The boiler is an apparatus to produce steam. Thermal energy released by the combustion of fuel is used to make steam at the desired temperature and pressure it is a closed vessel in which water or other fluid is heated. The fluid does not necessary boil.

II. WORKING PRINCIPLE OF BOILER

The basic working principle of the boiler is very simple and easy to understand. The boiler is essentially a closed vessel inside which water is stored. Fuel (generally cost) is burnt in a furnace and hot gasses are produced. These hot gasses come in contact with water vessel where the heat of these hot gases transfer to the water and consequently steam is produced in the boiler.Then this steam is piped to the turbine of the thermal power plant. There are many different types of boiler utilized for different purposes like running a production unit, sterilizing equipment, warming up the surroundings etc.

There are mainly two **types of boiler**:

1. Fire-tube boiler
2. water tube boiler

In a **fire tube boiler**, there are numbers of tubes through which hot gases are passed and water surrounds these tubes.
In **Water tube boiler** is the reverse of the fire tube boiler. In a water tube boiler, the water is heated inside tubes and hot gasses surround these tubes. These are themain two types of boiler but each of the types can be subdivided into manywhich we will discuss later.

III. FIRE TUBE BOILER

As indicated by the name, the fire tube boiler consists of several tubes through which hot gasses are passed. These hot gas tubes are immersed into water, in a closed vessel. Actually, in a fire tube boiler, one closed vessel or shell contains water, through which hot tubes are passed. These fire tubes or hot gas tubes heated the water and convert the water into steam and the steam remains in the same vessel. As the water and steam both are in the same vessel a fire tube boiler cannot produce steam at very high pressure. Generally, it can produce maximum 17.5 kg/cm and with a capacity of 9 Ton of steam per hour.

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IV. BOILER EFFICIENCY

There are two methods to measure boiler efficiency:

1. Direct method (input-output method)
2. Indirect method (Heat loss method)

DIRECT METHOD:

The direct method of boiler efficiency test is more usable or more common.

Boiler Efficiency = power out/power in = (Q*(HgHf))/(q*GCV)*100%

where,

Q = rate of steam flow in kg/h

Hg = enthalpy of saturated steam in kcal/kg Hf = enthalpy of feed water in kcal/kg

q = rate of fuel use in kg/h

GCV = gross calorific value in kcal/kg

INDIRECT METHOD:

To measure the boiler efficiency in the indirect method, We need thefollowing parameter:

- Ultimate analysis of fuel (H2, S2, S, C Moisture constraint, ash constraint)
- percentage of O2 or CO2 at flue gas
- Flue gas temperature at the outlet
- Ambient temperature in deg c and humidity of air in kg/kg
- GCV of fuel in kcal/kg
- Ash percentage in combustible fuel
- GCV of ash in kcal/kg

V. STEAM BOILER EFFICIENCY

The percentage of total heat exported by outlet steam in the total heat supplied by the fuel (coal) is called **steam boiler efficiency**.

Steam Boiler Efficiency (%) = (Heat exported by outlet steam / Heatsupplied by the fuel) *100

Steam boiler efficiency depends upon the size of the boiler used. The typical efficiency of a steam boiler is 80% to 88%.

AIR PRE-HEATER:

An air preheater (APH) is a general term used to describe any device designed to heat air before another process with the primary objective of increasing the thermal efficiency of the process. They may be used alone or to replace a recuperative heat system or to replace a steam coil.In particular, this article describes the combustion air preheaters used in large boilers found in thermal power stations producing electric power from e.g. fossil fuels.

The purpose of the air preheater is to recover the heat from the boiler flue gas which increases the thermal efficiency of the boiler flue gas which increases the thermal efficiency of the boiler by reducing the useful heat lost in the flue gas. As a consequence, the fuel gases are also conveyed to the flue gas stack at a lower temperature, allowing a simplified design of the conveyance system.

VI. BLOWDOWN VALVES FOR BOILERS

The main function of blowdown valves is to control a continuous flow of steam fluid under high differential pressure. The outstanding feature of this typeof valve is that it can maintain fluid-tightness and it is easily operated without the help of any wedging action.

Automated Globe Blowdown valves are a recognized standard in the sugar industry as they eliminate the need for the operator to manually blow down the boiler, typically on Mud Drum Blowdown applications. The Globe valves are built with a plug and seat, an oversized actuator and extended mounting bars. Flanges are 600 and they can be either on/off or used in modulating Mud drum blowdown valves are used on boilers to clean the drum of soluble and insoluble solids that collect at the bottom during normal operating conditions.

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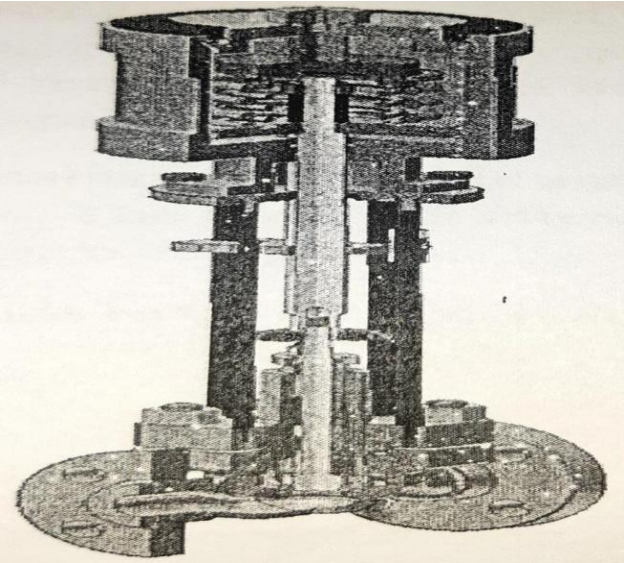

NAME	DESCRIPTION (Qualitative)
Turbidity	Finely, suspended matter, which does not settle impact a muddy or cloudy appearance to water.
Colour	Colour in natural waters is generally due to organics from decayed vegetation & organic wastes, causing water to vary from colourless to deep brown.
Suspended Solids	There are usually mineral or organic in origin un-dissolved matter causes turbidity & can plug lines, deposits in a heat exchanger.
Dissolved Solids	These are the substances that will dissolve in water The primary ones are the carbonates and sulphate of calcium and magnesium, which are the scale formation when heated. There are other dissolved solids, which are non-scale forming.
Total Solids	The sum of suspended solids and dissolved solids is determined gravimetrically.
Hardness	Calcium & magnesium salts are which are the chief source for scale.
Alkalinity	Bicarbonate(HCO3), carbonate(CO3) & Hydrate(OH) measured by titration, alkalinity can convert to CO2 in steam &cause corrosion.

TREATMENT APPROACH:

- A successful treatment approach requires a total system approach to:
- Prepare the water before it goes to the boiler.
- Maximize the potential of condensate.
- Provide internal boiler protection.
- Maintain clean internal boiler surfaces.
- Avoid problems and shutdowns.
- Extend equipment life.
- Monitor and control treatments levels.

WATER PROBLEMS

All raw water used for boiler makeup, irrespective of its source contains several impurities. Water, as it passes over the ground, picks up the limestone and other elements of nature which dissolve and remain. The common impurities are summarized

WATER IMPURITIES & THEIR EFFECTS:

IN context to the boiler water, the first noticeable observation is hardness which is composed primarily of calcium (Ca++) & Magnesium (Ma++) minerals. The hardness is primarily responsible for scale formation. The other elements & their effect on boiler surfaces are listed below

CALCULATION TEST ON BOILER

Using softened water indicates the following analysis

LOCATION	SILICA, (in ppm)	CONDUCTIVITY (neutralized)
Boiler Makeup	40	525
Condensate	3	45
Feed Water	20	265

SOLUTION:

From,

Equation:

$20VF = 40VM+3VC$ eqn-1

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VF = VM+VC……eqn-2

Where,

VF = Volume of feed water VM = Volume of makeup water VC = Volume of condensate

VC is the estimated condensate by solving equations 1 & 2

(eqn2*3) & (eqn1-(1))

17VF = 37VM

From which:

VM = 17*100/37 = 45.94% VC = 100-45.94 or 54.06%

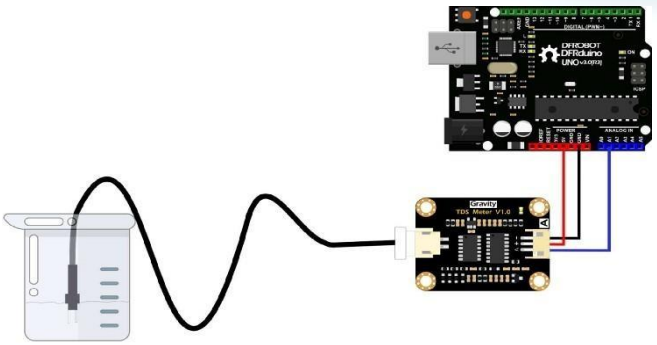
Result:

Therefore, condense-makeup is roughly 54% condensate & 46% make up water.

DEFINITION OF TDS (Total Dissolved Solids) SYSTEM

TDS meter is a small hand-held device used to indicate Total Dissolved Solids in solution, usually water. Since dissolved ionized solids, such as salts and minerals, increases the conductivity of a solution a TDS meter measures the conductivity of the solution & estimates the TDS from that reading.

WATER (In ppm)	CONDITION
Between 50-150	Drinking
150-250	Good
250-300	Fair
300-500	Poor



Best TDS Meter In india :

1. Genetic Digital
2. Ionix
3. Genetic Digital TDS-3
4. HM Digital AP-1
5. LUZON DZIRE
6. YUV'S
7. HM Digital TDS-3
8. GSK TDS

MERITS:

1. By Monitoring boiler inlet water parameter levels, we report the scale formation effects on the inner layer of the boiler, our project provides a report on the concentration of salt containment presented in a boiler with an indication system.
2. Scale formation is avoided on the layer, tends to increase in steam discharge, Fuel consumption, increase boiler lifetime & its efficiency as well.
3. The boiler water pH levels maintained.
4. Temperature (87 degrees recommended) pre-heated water is allowable is monitored
5. Turbidity, water impurities were strictly monitored & re-examined before the inlet to the boiler.

VI. Conclusion

Scale formation is the major barrier for steam formation on the layers of boilers, includes the water levels & their pH values, from our project we rectify the problem of boiler inlet water parameter levels with recommended reports.

We successfully impact the efficiency of the boiler as well as steam discharge discharge, the savings were achievable by control of scale amounts, reduction on their maintenance works, systematic routed themto the allowance range value for their concern.

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