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DESIGN AND DEVELOPMENT OF ELECTRIC BOILER

Roshan G Deshmukh [1], Prathamesh R. Patil[2], Vijay S. Rane[3], Ajinkya U. Kotwal[4], Pranil V. Rabad[5].

[1] *Roshan G Deshmukh, Assistant Professor in Department of Mechanical Engineering, S.S.J.C.O.E. Dombivli E, Maharashtra, India*

[2-5] *8th Sem Students in Department of Mechanical Engineering, S.S.J.C.O.E. Dombivli E, Maharashtra, India*

ABSTRACT - *The main problem of using renewable energy sources is their stochastic nature. In this study, we explored a system that can run on electric heater instead of using conventional fuels. The boiler system consists of two vessels connected in a series (the water drum and steam drum). The main boiler (water drum) provides the necessary temperature level using the energy from the heaters. The secondary boiler (steam drum) stores the steam that can be used for further working. Increasing the efficiency of the boiler, reduction of pollution, and sustainable solutions to conserve renewable resources are the major objectives of this study.*

Keywords: - Boiler, Renewable Resources, Electric heater, Water Drum, Steam Drum.

1. INTRODUCTION

In the last few years with the development in the economic structure of the country and rapid increase of electric demand, large capacity, high parameter, thermal power generating units takes part in the peak load operating process.

Boiler is one of the most important devices in a power plant or in industries where a source of steam is required as a source of heat. The Industrial Revolution of the eighteenth and nineteenth centuries drove a spectacular increase in energy requirements throughout Western Europe, the U.S., and other areas of the world. Some of the industries that blossomed, such as steelmaking, utilized a great deal of direct heating. A steam boiler is used to heat water into steam and this steam is circulated through a closed-loop piping system to transfer heat to a process.

The world changed forever with the invention of practical electrical systems in the early 1880s and development of steam turbines for power generation around the turn of the twentieth century .an electric steam boiler is a type of boiler where the steam is generated using electricity rather than through the combustion of fuel sources. Although they are expensive to run than other gases or oil fired boiler, they are popular because of their simplicity and ease of use. Electric boiler is used in industrial applications where a large amount of water must be converted to steam often under a short period of time.

Mostly fire tube boilers or water tube boilers are used in industries, our basic idea is to generate the steam with the help of heaters or electrodes for increasing boiler efficiency, reducing the pollution and generate the steam in minimum required time. In this highly competitive and developing society, time and non-renewable resources are critical factors for the completion of tasks on a large scale. Boiler is playing an important role in thermal power plants, food packaging, chemical, and many such industries. This electric boiler will run on electricity so there will be no fuel required to operate this boiler. Due to this reason, there will be great control of pollution. The consumption of fuel is increased to meet the requirement of the industries and at the same time availability of fuel is less

So a lot of research is going on alternative fuels in order to save conventional fuels. Rising need of switching to alternative fuels and alternative sources of energy. Electricity shows a bright spot in the current scenario.

2. LITERATURE SURVEY

Mr. Ashok Kumar and Mr. G. Kumar has worked on "Design and Thermal Analysis of Steam Boiler used in Power Plants" [1] using CFD analysis. It focuses mainly on thermal and CFD analysis with different velocities. Thermal analysis was done for the steam boiler by steel, stainless steel& brass at different heat transfer coefficient values. By observing the CFD analysis the pressure drop, velocity, heat transfer coefficient, mass flow rate & heat transfer rate increases by increasing the inlet velocities.Mr. D.Madhav done the research work on "Heat Recovery through Boiler Blow down Tank" [2] and has given suggestions as "Blow down water carries thermal energy in the form of steam which can be reused may result in improves the boiler efficiency. V. Ganapathy's book "Steam Generators and Waste Heat Boilers: For Process and Plant Engineers"[3] provides numerous examples on boiler thermal performance calculations that help plant

engineers develop programming codes with ease. It describes trends in large steam generator designs such as multiple-module; elevated drum design types of boilers such as D, O, and A; and forced circulation steam generators and illustrates various options to improve boiler efficiency and lower operating costs. The book examines recent trends and developments in boiler design and technology and presents novel ideas for improving boiler efficiency and lowering gas pressure drop and helps plant engineers understand and evaluate the performance of steam generators and waste heat boilers at any load.

3. PROBLEM DEFINITION

1. Fuel Crisis:

- As other boilers (fire tube and water tube boilers) mainly requires conventional fuels like coal, wood, etc. These conventional fuels are depleting day by day on a large scale and it may cause scarcity of conventional fuels in the future.

2. Pollution:

- As boilers burn fuels which releases some harmful exhaust gases in the environment which leads to environmental hazards as wells as health hazards.

3. Efficiency:

- As the other boilers uses hot gases to generate the steam in this process the heat dissipation is more so its efficiency decreases. But in electric boilers heat loss is very low. Hence we get more efficiency as compared to water tube and fire tube boiler.

4. Unwanted Heat:

- The working of other boilers generates lot of unwanted heat due to combustion which results in decrease in efficiency.

5. Design:

- As we are inserting electric heaters into the boiler the design gets compact. So it consumes less space than other boilers.

6. Safety:

- Over vaporization of the boiler.
- Insufficient water in boiler causing overheating and vessel failure.
- Pressure vessel failure of the boiler due to inadequate construction over maintenance.

4. OBJECTIVES

The main objectives of this project are:

1. To find substitutes for water tube and fire tube boilers because this type of boilers have lower efficiency i.e. about 60 to 80% only.
2. To develop eco-friendly and high efficiency electric boiler.
3. To reduce pollution as by this water tube and fire tube boilers which produce harmful exhaust gases which causes most of our environmental pollution. With the help of an electric boiler we can eliminate exhaust gases as there is no combustion hence we can call it as Green Engine.
4. To save conventional fuel as day by day number of vehicles are increasing due to development of automobiles as well as increasing population. As we know water tube and fire tube boilers use conventional fuels but increased demand doesn't get fulfilled by nature because we have limited amount of natural resources. As electric boilers doesn't require such fuels, so we can overcome the problem of fuel crisis.

5. WORKING

Our project consists of components like pressure gauge, safety bush, water level indicator, washer, buttons (Rockes Switch, 3 volts), Solenoid Valve, Pressure Switch, Relay Switch LRU-208, Steam jet, and Steam trap valve.

In this electric boiler, there are two hollow cylinders i.e. large one is the water drum and the smaller one is the steam collector drum. The water drum and steam collector drum are interconnected with the help of hollow pipes from which the steam can pass and the water drum and steam drum are kept horizontally. Holes of radius 5 to 5.5cm are drilled at the surface of the water drum through which the two electric heater of 2000 watts is inserted into the water drum. The feed water supplied to the water drum is regulated or controlled by the feed check valve.as the water is filled into the water drum, electric supply is provided to the two heaters inserted into the water drum.as the water reaches to its boiling point, after that the water vapor starts forming(steam).the steam then gets collected in the steam drum and is then supplied for the various operations.in this study, pressure on water in water drum is about 6 bar and the boiling point of water is 158 °C.

6. DESIGNED CONCEPT

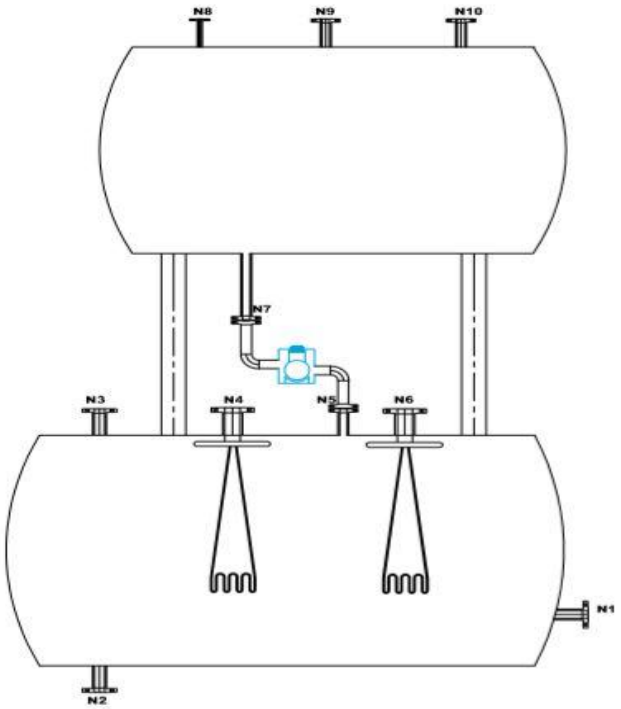

FIG 1: Designed concept of electric boiler

7. CONCLUSION

The objective of this study was to analyze the overall efficiency and thermodynamic analysis of boiler by using electric heater instead of conventional fuel. There are many factors which are influencing the efficiency of the boiler like load fluctuation, type of material, quality of water, TDS in water.

8. REFERENCES

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