

## Improving Boiler Efficiency by using Economizer

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**Abstract**— The steam generating using a boiler is widely utilized in industry and power plants. A big portion of the world's energy consumption is getting used in boilers. A small improvement within the efficiency of the boiler will help save an outsized amount of fuel and also help to reduce CO<sub>2</sub> emissions. Therefore in this paper, we concentrated an approach toward the improvement of boiler efficiency by recovering a portion of the heat content of the flue gas. This is possible due to the most dominant device means an economizer. A boiler economizer works on the principle of heat transfer i.e., this device is nothing but a heat exchanger that uses the remaining energy of flue gas to heat the inlet water to the boiler. The recovered heat can also be utilized to preheat boiler feed-water, combustion air, or some other applications. Economizers also increasing the efficiency of the boiler will save you a lot of operating costs and eventually extend the life of the boiler system.

**Keywords:** Waste heat recovery, Boiler, Economizer, Boiler Efficiency, Energy Saving, Losses In boiler, Global Warming

### I. INTRODUCTION

Basic human needs can only be met through industrial growth, which relies heavily on energy supply. In the last few decades, the huge growth of the population and The growths of industrial development have put a heavy burden on the electrical utility industries and processing plants producing fertilizers, petrochemicals, chemicals, and many other essential commodities, resulting in the need for extra capacity within the areas of power and steam generation throughout the world. Steam is employed in nearly every industry, and it's documented that steam generators and warmth (heat) recovery boilers are vital to power and process plants. it's no wonder that with rising fuel and energy costs engineers in these fields are working on innovative methods to urge electricity, improve energy utilization in these plants, recover energy efficiently from various waste gas sources, and simultaneously minimize the impact these processes wear environmental pollution and therefore the emission of harmful gases to the atmosphere. Boilers are pressure vessels utilized in buildings and industrial facilities for heating water or producing steam. They're primarily used for providing space heating for buildings in temperate climates also for producing hot water and steam required by users like laundries, kitchens and other many applications.

Boilers are either hot water boilers or steam boilers and are ready to burn fossil fuels like oil, gas, and coal [5] (some use electric current), but Fossil fuels like coal, gas, oil, etc., and nuclear energy, are being used to generate a major portion of world's electricity and usually, the boiler is the simplest way and also best option to convert these types of energy into electricity. Therefore, it is clear that

increasing the efficiency of a steam boiler only marginally will reduce electricity consumption in large quantities.

Most industrial heating systems use boilers to either produce hot water or generating steam. Therefore, an efficient boiler also has a significant impact on heating-related energy savings [6]. Larger energy savings can be achieved by adopting energy-saving measures and improving overall boiler efficiency.

This paper focuses on waste heat recovery using Economizer. The main objective of this paper is improving Boiler efficiency by recovering waste heat carries by flue gases. And at the same time also focus on how to control the emissions.

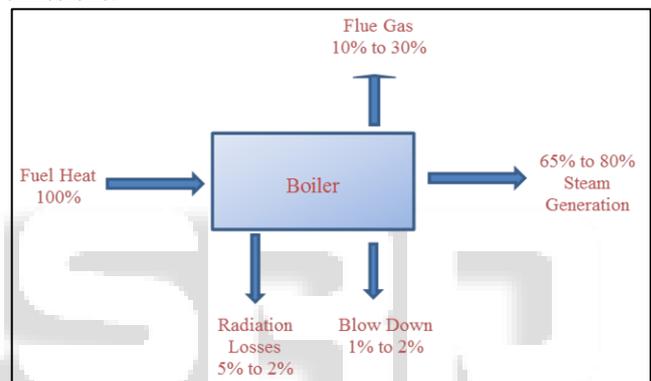


Fig. 1: Typical heat balance in a boiler [5].

### II. LITERATURE REVIEW

In the combustion chamber of the boiler, fossil fuels are burned and the heat generated is transferred to the water by hot flue gas. Flue gas destroys a significant amount of energy because all the heat produced by the burning fuel cannot be transferred to the boiler in water or steam. Because the temperature of the flue gas release a boiler typically ranges from 150 to 250 °C, about 10 -30% of the heat energy is lost through it [1]. Other major heat losses from boilers include convection heat transfer, radiation, blow-down, fly ash and bottom ash losses. In order to operate the boiler plant at maximum efficiency, it is necessary to identify the main source of energy wastage and recover the wasted energy [2].

The efficiency of the boiler is that the ratio of the net amount of heat that's absorbed by the generated steam to the net amount of heat that's supplied to the boiler. This will even be determined by subtracting net heat loss from the boiler from the net amount of heat supplied to the boiler [3]. Therefore, so as to enhance the efficiency of the boiler, it's necessary to scale back the quantity of heat being wasted from the boiler by optimizing some parameters like extra air, fuel flow rate, steam demand, some other parameter [4]. A typical heat balance in a boiler as shown in fig.1 [5].

According to Fig. 1, 10-30% of the input heat is wasted by flue gas and it is the highest source of heat loss in the boiler system. Since the majority of the heat is wasted by the high-temperature flue gas, the recovery of heat from high-temperature exhaust can lead to energy savings. Harnessing the waste heat from the heat temperature flue gas can have a great potential for energy saving for the boiler system.

### III. HEAT RECOVERY FROM FLUE GAS

According to the above literature, it is clear that the temperature of the flue gas leaving a boiler (boiler exhaust temperature) typically ranges from 150 to 250 °C due to the limitation within the heat transfer area between combustion products and water or steam and condensation of flue gas. Thus, an enormous amount of heat energy is lost through boiler exhaust or flue gasses. Approximately 10-30% of the input energy can be lost by high temperature flue gas [6]. Therefore, the efficiency of the boiler can be improved by recovering a portion of the total heat content of the flue gas. This heat can be used as a heat source for preheating combustion air, for boiler feed water in boilers or for other purposes such as absorption chiller.

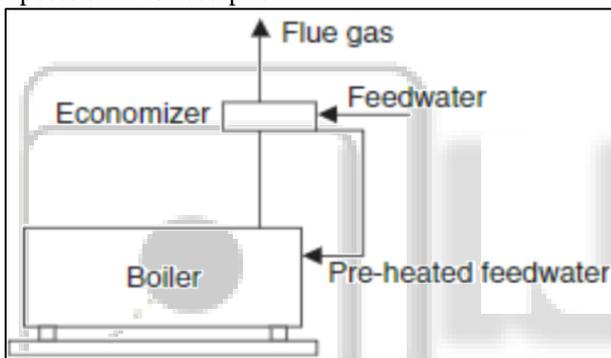


Fig. 2: Typical arrangement of economizer [2].

#### A. Economizer

The exhaust gases that are leaving the Boiler contain both sensible heat and latent heat. Sensible heat is the amount of heat needed to raise the temperature of water under constant pressure without changing the liquid state, while

Latent heat is required to change Liquid state to the Vapour state at constant temperature and pressure.

The exhaust from the boilers is usually within the temperature range of 150°C – 250°C, so there is an enormous amount of losses from the boiler if any heat recovery devices aren't installed after it.

After producing steam, the flue gas exits the system but flue gas remains some amount of heat energy. A boiler economizer is a device that uses the remaining energy of flue gas to heat the inlet water to the boiler. The recovered heat can be utilized to preheat boiler feed water, combustion air, or some other applications. The amount of heat recovered totally depends on the temperature of the flue gas and also the temperature of the fluid to be heated. In the boiler, an economizer usually has a heat exchanger designed to exchange heat with fluid, usually water. And also help reduce the cost of operation by saving fuel.

Economizers also increasing the efficiency of the boiler will save you a lot of operating costs and eventually extend the life of your boiler system.

### IV. CONCLUSION

In conclusion, the exhaust gases which are leaving from the boiler has very high-temperature means these exhaust gases have very huge potential to recover heat and utilized in diverse processes. So there are a huge quantity of heat energy is lost from the boiler if any heat recovery equipment is not installed in after it.

In this regard, a comprehensive review is presented for the waste heat recovery from exhaust gases. It was investigated that, one of the dominant method of waste heat recovery using an economizer. The economizer is used to reduce total energy consumption by creating additional heat sources. High-temperature flue gases leaving the boiler are entered into economizer due to this prevents high-temperature flue gases are coming in contact with the environment. Also, an economizer device would reduce the impact on the environment by reducing emission which may very helpful to control global warming. Therefore this comprehensive review of waste heat recovery of flue gases using economizer is very helpful to improve boiler efficiency in an industrial area.

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