

EFFICIENCY IMPROVEMENT OF BOILER THROUGH DESIGN OPTIMIZATION AT KUWAIT OIL AND GAS COMPANIES

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ABSTRACT

For a plant engineer, the boiler efficiency is one of the most crucial aspects. Therefore, different techniques are developed to improve the boiler performance. In the several studies, it is found that a boiler consumes the energy around eighty percent of the boiler operating cost. The efficiency of a boiler suffered due to the various losses occurred. These losses are mainly occurred due to the flue gas accumulation, unburned fuel, convective and radiated heat loss. To improve the efficiency of a boiler, the design optimization is studied in this research.

In this study, several parameters such as pre-heater design, economizer design, an efficient heating system design, etc., are used. In a boiler, heat loss is very high when the flue gas released almost thirty percent of the energy loses due it. Therefore, it is essential to optimize the design of a boiler so that the performance can be improved. In a boiler design, complex geometry is used because it has multiple inputs and multiple outputs. This system is of a non-linear type which has no self-balancing mechanism. The combustion process of a boiler is also complicated in terms of physical as well as chemical process. A boiler is used for various applications such as food industries, cement industries, etc. The efficiency of a boiler is required to improve due to multiple reasons such as energy savings, low maintenance cost, and environmental safety, etc. Recent days, everyone is developing a design that can help in energy conservation on the urge of pressing environmental issues such as global warming. In several industries and power plants, boilers are primarily used for generating steams or producing hot water. Several studies showed that the consumption of energy in boilers is significant (M.C. Barama et al. 2017). Therefore, improving the boiler efficiency even in small amount can lead to save a significant amount of energy. It can also help to improve the carbon emission that will be a significant step towards the environmental safety.

By definition, a boiler is a pressure vessel which is used for generating electricity or supplying the hot water to the industry for providing the heating facilities depending upon the requirements. In some commercial and residential buildings, boilers are used for providing hot water or steam facilities for various domestic and commercial purposes (L. Jayamaha, 2006). In all over the world for generating electricity, coal, gas, etc., and nuclear power is primarily used. For converting energy generated by these resources, for example, thermal energy into electricity, boilers are one of the suitable options. The fossil fuels reserves are depleted day by day and the demand for other energy resources such as oil, gas, and coals, etc., for electricity production are increasing. According to a study, these energy resources demands will reach 47.5% - 94.7% by the end of 2030 (M.C. Barma et al., 2017), (S. Som and A. Dutta, 2008). Therefore, improvement in boiler efficiency is crucial.

In a steam boiler, chemical energy obtained from the fuel is transformed into the thermal energy with the help of combusting fuels in the furnace. These days the design of a boiler are getting more complex as more number of equipment are connected such as heat exchanger, pre-heater, economizer, etc.

KEYWORDS: *Efficiency Improvement of Boiler, Kuwait*