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Analysis of Coal Combustion in A Sub-Critical Boiler of A Thermal Power Plant

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***Abstract*- Coal is a combustible substance which has 50% organic matter and remaining carbonaceous matter and moisture. Coal is the major source of fuel used in thermal power plant. The chemical energy contained in the coal is converted to useful heat in a chamber called boiler furnace. The proximate, volatile and total analysis is essential in determining the characteristics of coal and their influence on combustion efficiency.**

***Keywords*--Coal, Combustion Efficiency, Coal Analysis, carbon content, Volatile matter**

I. Introduction

Fixed carbon in the coal plays an important role in the combustion efficiency of a coal fired thermal power plant. Since the coal structure changes variably, its properties also change considerably. The useful heat content of the coal by found by determining the fixed carbon content as it directly involves the useful heat transfer rate. The quality of coal is determined mainly by the amount of mineral that is present coal in the lot [1].

The combustion optimisation for a coal fired boiler is determined by change of boiler heating surface [2]. The cause of incomplete combustion and associated heat loss is influenced by number of factors of fly ash and bottom ash content [3]. The influence factors of heat loss should be analysed and the optimised measures with relation to the actual is performed [4].

The content of coal varies as 3M components : Macreal, Mineral and Moisture. Around 50% of the content of coal is of organic matter which comes out of remain of plants, trees, that undergo decomposition and change of physical and chemical properties occur over a period of time.

The maceral component of coal is the microscopic organic constituent of coal. Hence the proximate, volatile and total analysis are needed to evaluate the amount of fixed carbon, moisture content, ash, volatile matter and various elemental content. Many of the technical problems associated by on burning the coal is dependent on the mineral matter. The accumulative behavior of coal is the understanding of the elemental composition.

II. Coal Analysis

The key parameters which determine the quality of the coal are its Fixed carbon content, volatile content , moisture content and ash content.

A. Determination of Moisture content

Normally 1 gram of pulverised coal is taken in a crucible furnace and heated to around 100 degree C for 60 Minutes. The loss in weight of the coal is now is found and the percentage of moisture content Is found using the equation below.

$$\%\ of\ Moisture\ content = \frac{Weight\ Loss\ in\ coal}{Weight\ of\ coal\ handled} x\ 100$$

Equation(1)

B. Determination of Volatile Matter

The furnace with the coal residue is covered and heated to 900 degree C for around 6 to 7 minutes using an electric heater. The loss in weight of the sample is found and the percentage of the volatile matter is found using the equation (2)

$$\%\ of\ Moisture\ content = \frac{Weight\ Loss\ in\ coal}{Weight\ of\ moisture\ free\ coal} x\ 100$$

Equation(2)

C. Determination of Ash content

The left out residue is then heated without lid to 700 Degree C for half an hour in an electric furnace. The loss in weight of sample is found and the percentage of ash content is calculated using the equation (3)

$$\%\ of\ Ash\ content = \frac{Weight\ of\ Ash\ formed\ from\ coal}{Weight\ of\ air\ dried\ coal} x\ 100$$

Equation (3)

Hence the fixed carbon content is found as below,

$$\%\ of\ Fixed\ Carbon = 100 - \%\ of\ (Moisture + Volatile\ Matter + Ash$$

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D. Calorific value of coal

The calorific value of coal is the total quantity of heat liberated when 1 kg of coal is burnt completely. All coal contain hydrogen and while burning it is converted to steam. If the products of combustion are condensed at room temperature, the latent heat of condensation of steam also is included in the measured heat termed as higher or gross calorific value.

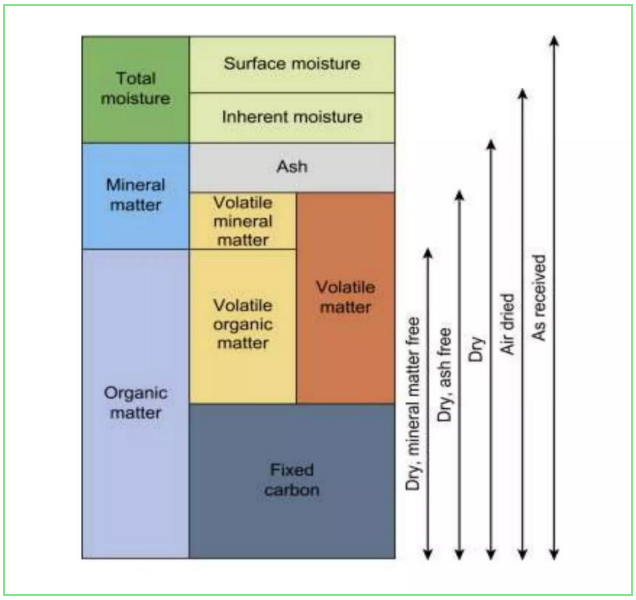


Figure No.1 Analysis of coal

The series of removal of surface moisture, inherent moisture, with respect to fixed carbon, volatile organic matter, volatile mineral matter and ash is depicted in figure no.1.

III. Conclusion

Chemical reactions of the combustion process of pulverised coal is a critical task. The combustion efficiency can be optimised by the proper complete combustion of coal and to reduce the Carbon monoxide generation. Hence a thorough knowledge of the analysis of coal with respect to burning parameters should be analysed and heat loss from carbon should be reduced considerably.

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