



Coal Blending and its effects on Boiler Performance

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WHY BLEND COAL

- To meet coal demand
- To improve the performance
- Helping to solve the existing problems
- Controlling the mineral contents of coal
- Providing fuel that possess better combustion properties



COAL PROPERTIES AFFECTING BOILER PERFORMANCE OF BLENDED COAL

- Fixed carbon, Volatile matter
- Moisture, Ash, Calorific Value
- Ignitability, Ash Composition



CALORIFIC VALUE CALCULATION IN THE ULTIMATE AND PROXIMATE ANALYSIS OF COAL

1. Dulong's expression (Ultimate Analysis)

$$\text{HHV} = 81C + 342.5 (H - O/8) + 22.5S \text{ (kCal/kg)}$$

➤ where C, H, O & S shows the Wt. %

2. Kosaka's expression (Proximate Analysis)

$$\text{HHV} = 81C + (96 - \alpha * W) * (V_m + W) \text{ (kCal/kg)}$$

➤ Where α is the coefficient of moisture and is used as the following values:

When $W < 5.0$; $\alpha = 6.5$

When $W \geq 5.0$; $\alpha = 5.0$

➤ Where C, W and V_m shows the Wt. %



EFFECT OF VOLATILE MATTER ON BOILER PERFORMANCE

- If the blend contains two coals with significantly different volatile contents, two flames can develop, based on the de-volatilisation of each of the blended coal.
- Blending of a low volatile coal with a small proportion of high volatile coal aids in flame stability and uniform heat transfer in boiler.
- A sudden dip in volatile matter value of the fuel due to inhomogeneous mixing of blended coals, will lower the flame temperature thereby dipping radian heat transfer in furnace. If the Carbon is relatively unreactive, this will increase the unburnt carbon in bottom ash.



EFFECT OF VOLATILE MATTER ON BOILER PERFORMANCE

- When the Volatile matter of the blended coal is low, flame stability decreases (Continuous support of oil may be required for normal operation)
- When the Volatile matter of the blended coal is high, pulveriser outlet temperature is to be decreased correspondingly which will directly reduce the boiler efficiency.



EFFECT OF FIXED CARBON ON BOILER PERFORMANCE

- Fuel Ratio = Fixed carbon/ Volatile matter
- When the Fuel ratio % of the blended coal is High; the unburnts in combustion will increase which leads to poor boiler efficiency.



EFFECT OF MOISTURE ON BOILER PERFORMANCE

- When the moisture of the blended coal is high, coal needs more heat for drying effecting economiser and airheater sizing, pulveriser capacity reduce (more no. of mills may be required for normal operation)
- High moisture decreases boiler efficiency through latent and sensible heat



EFFECT OF ASH ON BOILER PERFORMANCE

- The percentage of ash present in the fuel and the characteristic of ash dictates the sizing of the furnace.
- Fuel with ash characteristics leading to slagging and fouling requires a conservatively sized furnace since ash quantity influences the furnace heat transfer by shielding the radiation. Flame temperature lowered by increased ash quantum.



EFFECT OF ASH ON BOILER PERFORMANCE

- Indian coal contains high quantum of ash; consequently the heat released by fuel will be held up by the ash and will be released slowly and this necessitates a bigger furnace. Higher the ash quantity, greater the shielding of furnace walls.
- The downstream pressure parts like SH, RH, Eco are to be arranged and space in such a way that the velocities are kept low to avoid erosion.
- The heat from the ash will take part in heat transfer in second pass



IGNITION AND FLAME STABILITY

- Low rank coals have lower ignition temperature
- Higher volatile content ensures flame stability
- Like the volatile matter yield, the heating value contained in the volatiles influences flame stability and heat release profile in a boiler.
- Two blended coals with same Proximate analysis may not have the same ignition and flame characteristics.
- Blending low and high volatile bituminous coals may result in a fuel with good combustion properties.



IGNITABILITY INDEX

$$\text{I.I.} = \frac{[(\text{raw coal calorific value kCal/kg}) - 81 * (\text{Fixed carbon\%})]}{(\text{volatile matter \%}) + (\text{moisture \%})}$$

If the ignitability index is 35 or less, it is said some measures for ignitability improvement should be taken.



Thank you