EVALUATION OF QUALITY OF COAL OF EASTERN COAL FIELD AND IMPORTED COAL BLEND

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ABSTRACT

This study examines the quality characteristics of coal from Eastern Coalfields Limited (ECL) and compares them with imported coal, focusing on their performance when blended. As power generation increasingly relies on consistent fuel quality, blending domestic and imported coal has become essential for enhancing efficiency and reducing emissions. Laboratory analyses, including proximate and ultimate tests, calorific value measurement, and ash fusion assessments, reveal that ECL coal typically has higher ash and lower energy content compared to imported coal. However, blending trials indicate that strategic mixing can improve combustion performance and reduce harmful emissions like SOx and NOx. The findings support the development of optimized blending strategies that balance cost, performance, and environmental requirements. This research offers valuable guidance for energy planners and thermal plant operators seeking to improve fuel utilization in coal-based power systems.

KEY WORDS: Coal blending, Eastern Coalfields Limited, Fuel efficiency, Calorific value.

1. INTRODUCTION

The energy industry, especially power generation, is vital to satisfying worldwide electricity demand. As long as the globe uses fossil fuels for electricity, thermal power plants use coal. Due to its abundance and affordability, coal is crucial for electricity generation. However, coal quality varies substantially by source, which can affect power plant performance, efficiency, and emissions. For maximum energy efficiency and minimum power generation environmental effect, a constant fuel supply with excellent combustion characteristics is essential. But imported coal has less ash, higher calorific value, and less sulfur, making it a better power source. Many developing nations, like India, struggle to import coal due to its high cost. Blending indigenous and imported coals has proven helpful in overcoming their shortcomings. Coal blending, which balances cost, performance, and environmental sustainability, has grown in popularity. Power plants may optimize combustion performance, efficiency, and SOx and NOx emissions by carefully adjusting blending ratios.

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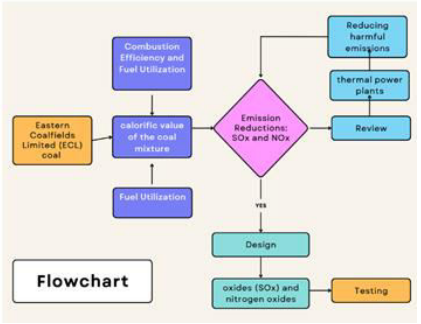

Fig.1. Flow chart

Coal quality has been an issue due to its high ash content and lower calorific value than imported coals. Despite these obstacles, combining ECL coal with imported coal has improved combustion and reduced hazardous emissions. Strategically combining ECL coal with imported coal boosts calorific value and decreases sulfur content, reducing SOx emissions. plants while meeting the growing need for cleaner and more efficient power.

Fig. 2. Chp plant

2. LITERATURE REVIEW

Research has focused on coal quality and thermal power plant combustion performance, particularly when combining native and imported coals to improve fuel use. Growing reliance on coal for power production requires improved control of coal's inherent quality features to improve combustion efficiency, decrease operating costs, and reduce hazardous emissions. This section analyzes research and literature on coal quality analysis, coal blending, and environmental issues, focusing on Eastern Coalfields Limited (ECL) coal and its performance when blended with imported coal.

Effects of Coal Quality on Combustion:

Proximate and ultimate studies evaluate moisture, ash, sulfur, volatile matter, and fixed carbon to determine coal quality. These factors drive combustion, impacting boiler performance and power generating efficiency. Sharma and Soni (2013) found that high-ash coal causes boiler wear, greater maintenance costs, and worse heat transfer efficiency. High sulfur concentration in coal produces sulfur oxides (SOx) during burning, which pollutes the air and causes acid rain (Bansal et al., 2017). Improved coal quality is crucial for more efficient electricity generation.

Another important metric is coal's calorific value, which defines its energy content and how much coal is needed to create a certain quantity of power. Kumar et al. (2016) found that ECL coal has a lower calorific value than imported coal, which increases power plant fuel usage. The Indian power sector has long struggled with this issue since native coal, such as ECL coal, requires more coal to provide the same energy output than imported coal, which has a greater calorific value and lower ash content.

3. METHODOLOGY

The effects of blending on combustion performance and emissions are examined in this study, which compares Eastern Coalfields Limited (ECL) coal and imported coal using laboratory analyses, experimental blending trials, and performance assessments. The study seeks optimal blending solutions to optimize fuel consumption, pollution, and coal-based power plant efficiency. Coal sample and characterisation, blending trials, and performance evaluation comprise the technique.

Sample Collection: ECL mine and imported coal samples are acquired from various sources to reflect typical coal quality. ECL coal samples are taken from Eastern Coalfields mines to allow for quality variation. For comparison, a range of imported coals with low ash, high calorific value, and low sulfur content are chosen.

Calorific Value Measurement: A bomb calorimeter measures the energy content of each coal sample to estimate its heat output per unit.

Fig.3.Calorimeter measures the energy content of each coal sample to estimate.

Ash Fusion Temperature: High-temperature coal ash behavior is investigated for fusion features. This is crucial to understanding boiler combustion slagging and fouling.

Parameter	ECL Coal	Imported Coal	50% ECL + 50% Imported Coal Blend	30% ECL + 70% Imported Coal Blend	70% ECL + 30% Imported Coal Blend	Parameter
Ash Content (%)	32%	18%	25%	22%	28%	**Ash Content (%)**
Moisture Content (%)	11%	7%	9%	8%	10%	**Moisture Content (%)**
Volatile Matter (%)	23%	30%	26%	28%	25%	**Volatile Matter (%)**
Fixed Carbon (%)	48%	58%	51%	55%	53%	**Fixed Carbon (%)**
Sulfur Content (%)	1.80%	0.90%	1.40%	1.30%	1.60%	**Sulfur Content (%)**
Calorific Value (kcal/kg)	4200	5700	5100	5000	4900	**Calorific Value (kcal/kg)**
Ash Fusion Temperature (°C)	1150	1350	1250	1300	1280	**Ash Fusion Temperature (°C)**

Table 1. High-temperature coal ash behavior is investigated for fusion features

Operational Impact: The impact of coal blending on the thermal efficiency of power plants is assessed. Performance parameters such as fuel consumption, boiler efficiency, and maintenance requirements are monitored over an extended period. The reduction in ash-related issues, such as slagging and fouling, is also considered, as these issues lead to higher maintenance costs and reduced boiler lifespan.

4. RESULTS

This study included extensive laboratory tests and blending trials on Eastern Coalfields Limited (ECL) and imported coal samples. The investigation examined coal quality variations and how combining these two kinds affected combustion performance and emissions. Key discoveries are included below: coal averaged 32% ash compared to 18% for imported coal. ECL coal's high ash concentration causes boiler slagging and fouling, reducing combustion efficiency. ECL coal averaged 11% moisture compared to 7% for imported coal. ECL coal may need more energy to ignite and burn. ECL coal averaged 23% volatile matter vs 30% in imported coal. This shows that imported coal can ignite faster and burn more efficiently.

Ultimate Analysis:

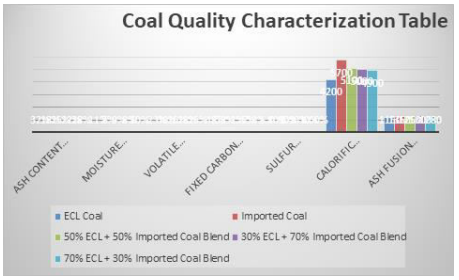

Fig. 4. ECL coal had a higher sulfur content (around 1.8%)

ECL coal had a higher sulfur content (around 1.8%) compared to imported coal, which had 0.9% sulfur. The higher sulfur content in ECL coal contributes to increased sulfur oxides (SOx) emissions during combustion.

Calorific Value: The calorific value of ECL coal was lower than that of imported coal. The average calorific value of ECL coal was approximately 4200 kcal/kg, while imported coal had an average of 5700 kcal/kg. This difference in energy content means that more ECL coal is required to produce the same

amount of energy as imported coal.

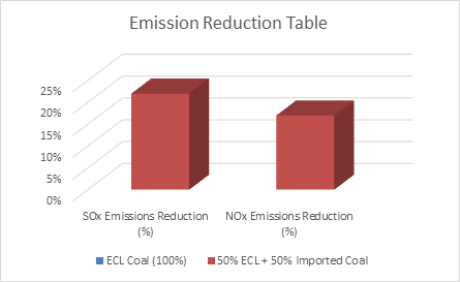

Fig. 5. Coal, the 70% ECL + 30% imported coal

Due to the increased energy level of imported coal, the 70% ECL + 30% imported coal mix had better ignition time and consistent combustion than the other blends.

Cuts in emissions: Blending ECL coal with imported coal significantly lowered SOx and NOx emissions. Compared to burning ECL coal alone, the 50% ECL + 50% imported coal blend reduced SOx emissions by 22% and NOx emissions by 17%.The report suggests a 50% ECL + 50% imported coal blend for power plants that balance performance, emissions, and cost. This combination optimizes combustion efficiency and curbs fuel expenses.

5. DISCUSSION

This study shows that combining Eastern Coalfields Limited (ECL) coal with imported coal may improve combustion performance, reduce emissions, and optimize fuel use. ECL coal's lower calorific value and higher ash content present obstacles, but blending can solve them. We describe how these discoveries affect electricity generation, pollution management, cost-effectiveness, and operational performance. ECL coal and imported coal are blended to improve combustion efficiency. Blending increases the calorific value of the coal combination, with the 50% ECL + 50% imported coal blend attaining 5100 kcal/kg, up from 4200 kcal/kg for ECL coal alone. Since less coal is needed to produce the same energy, blending improves fuel efficiency. Power plants need this because it influences fuel consumption, operating costs, and combustion efficiency.

Although the 70% ECL + 30% imported coal blend had the highest proportion of ECL coal, it still performed well, showing that blending with higher-grade imported coal can improve ignition time and combustion stability even with a higher proportion of lower-quality domestic coal. This mix may be effective in places with expensive imported coal and power plants that must balance efficiency and cost.

6. CONCLUSION

Eastern Coalfields Limited (ECL) coal was compared to imported coal for power generating performance in this study. The results show that mixing domestic coal (ECL) with imported coal may increase combustion efficiency, minimize hazardous emissions, and maximize fuel consumption in thermal power plants, solving coal quality issues. ECL coal is abundant and cheap, but it contains more ash, lower calorific value, and more sulfur than imported coal. Lower combustion efficiency, higher SOx and NOx emissions, and boiler wear and tear owing to slagging and fouling result from these variables. However, strategically combining ECL coal with imported coal solved these problems. Blending testing showed that the 50% ECL + 50% imported coal mix produced the highest calorific value of 5100 kcal/kg, compared to ECL coal's 4200. Fuel efficiency increases with energy content, lowering coal use for the same energy production. This mix reduced SOx emissions by 22% and NOx emissions by 17%, demonstrating the environmental benefits of blending, notably in lowering air pollution and meeting tighter emission limits.

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