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COMPARATIVE PROPERTIES OF BITUMINOUS COAL AND PETROLEUM COKE AS FUELS IN CEMENT KILNS

Bituminous coal has been in use as a fuel in cement kilns for a long time. With coal costs continuously rising, cement plants have been looking for alternative less expensive fuels.

Petroleum coke presents a viable alternative because of its lower cost since it is a byproduct of the refining process. It has a high heat value and low ash content, which favor its use in cement kilns. However, petroleum coke presents some challenges, such as high sulfur content and poor grindability, compounded by the need to grind it finer due to a low volatile content.

The following table provides a comparison between bituminous coal and petroleum coke with respect to their characteristics and operational and emission aspects. The comparison is on a very broad basis and an evaluation is required for each specific coal and petcoke origin.

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COMPARISON BETWEEN BITUMINOUS COAL AND PETROLEUM COKE				
	Coal	**Coke**	**Comments**	**Mitigation Measures**
EMISSION				
SO_2 emission: (Depends on % S in fuel and alkali content in the raw mix)	Low	High	Typically Petroleum coke comes with 4 – 7% Sulfur content.	Lime injection. Alkali balance. Process strategy.
NOx emission: (Petroleum coke is low in volatiles and the combustion occurs at a higher temperature)	Low	High	High flame temperature in the kiln generates higher thermal NOx	Multi staged combustion technique and SNCR (Selective Non Catalytic Reduction) technology.
OPERATION				
Coating formation and preheater plugging	Low	High	High sulfur increases circulation of volatiles and potentially cause plugging in preheater	Alkali balance and operational strategy Sulfur bypass
Grinding load	Low	High	Petcoke is hard to grind and needs finer grinding	No remedy However, lower fuel requirement due to higher heat value.
Raw mix design	Higher ash levels	Low in ash	Raw mix needs to be adjusted for ash absorption	
SAFETY				
Fire and explosion hazard	high	low	Low volatile content makes petcoke safer to handle	Inerting systems and explosion vents are required.
CLINKER QUALITY				
SO_3 content in clinker	low	high	Permissible SO_3 content in clinker limits the use of some petcokes	
CHARACTERISTICS				
% Ash Content	14 – 20	0.5 – 1.0	Petroleum coke is superior in heat content due to lower ash content.	
% Fixed Carbon	55 – 60	82 - 87	Higher carbon content gives higher calorific value (CV).	
% Sulphur	0.5 – 1.0	4 - 7	Creates emission of SOx and Operational problems.	Please refer to point A1 and B1
Gross C. V. kcal/kg	6000 - 6200	8000 - 8200	With higher calorific value less amount of Petroleum coke is required.	
Hardness – HGI The lower the HGI, the harder to grind.	50 – 55	35 - 40	Higher grinding (electrical) energy due to lower HGI.	

Petroleum coke is a viable alternative fuel to Bituminous Coal provided the challenges associated with it are properly addressed.

The quality of Petroleum coke varies from source to source. Depending on the refining process, various types of Petroleum coke are produced.

To ensure a successful operation, a detailed study based on the characteristics of the raw material and Petroleum coke to be used is required.

Additional investment may be envisaged for incorporating technology that supports use of Petroleum coke as fuel and for controlling environmental emission levels.

The use of petroleum coke may be limited by its high sulfur content. Technological measures such as finer grinding, pre-calciners designed to have a higher retention time, an external combustion chamber before the calciner, a special high-momentum kiln burner, etc. will help to effectively utilize Petroleum coke.

Based on the quality of Petroleum coke, typically a mixed fuel firing is designed. The percentage of Petroleum coke is determined based on quality and operational trials.

This article was contributed by Jagrut Upadhyay, Senior Process Consultant, and Narayana Jayaraman, Director – Technical Services at PEC Consulting Group.