National Council for Cement and Building Materials

ALTERNATE FUELS FOR VERTICAL SHAFT KILN CEMENT PLANTS

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NCB TECHNOLOGY DIGEST

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INTRODUCTION

ALL vertical shaft kiln mini cement plants using black meal process warrant low volatile fuel in order to ensure least intranodule pressure. Accordingly coke breeze, a waste product from steel industry is so far being used extensively as fuel in VSK cement plants. However, the growth of VSK mini cement plants all over the country and dwindling availability of coke breeze due to its recycling adopted by the steel plants has created pressure on the availability of this ideal fuel. In this background, NCB took up an R&D project under which various alternate fuels have been identified and their suitability established through plant trials. The projected requirement of fuel by 1994-95 is approximately 10 LTPA.

ALTERNATE FUELS

The sources and availability of various low volatile fuels which can substitute coke breeze both from the view point of quality and availability are as follows.

SLV Coal

The Saleable Low Volatile (SLV) coal or the Jhama coal is the result of carbonisation of coal seams by the intrusion of mica rich ultrabasic rock. This deposit is generally distributed in Jharia Coalfield of Bharat Coking Coal Ltd (BCCL), East Bokaro Coalfield of Central Coalfields and Raniganj Coalfield of Eastern Coalfields. Although the net geological reserves of Jhama coal have been estimated as 1224 million tonnes, the immediately mineable reserves of SLV coal have been reported as only 51.5 million tonnes as outlined in Table 1.

TABLE 1

SLV COAL IN SELECTED BLOCKS OF JHARIA COALFIELDS

Sl No	Block	Seam	Area (sq km)	Net Geological Reserves (million tonnes)
1	Kustore	XV	2.7	12.0
2	Kustore	XIV	1.6	15.0
3	OCP–VIII*	XIV	0.9	5.0
4	Mukunda (Exploration Block)	XIII	0.6	2.0
5	ECC Kenduadih	XV	1.0	4.5
6	ECC Kenduadih	XIV	1.0	3.5
7	ECC Kenduadih	XIII	0.5	1.5
8	Hurriladih-Burragarh	XIV	1.4	8.0
			Total	51.5

*(Parts of Gopalichuk, Kenduadih & Alkusa collieries)

The analyses of typical SLV coal samples collected by NCB from Kustore, Ena and Alkusa collieries of BCCL are given in Table 2.

TABLE 2

PROXIMATE ANALYSES OF SLV COAL

Particulars	SLV Coal				
	Kustore		*Ena*		*Alkusa*
	Sample I	Sample II	Sample I	Sample II	
Moisture, %	1.85	1.18	0.17	0.39	0.48
Ash, %	22.39	25.10	19.59	29.30	38.56
Volatile matter, %	4.42	6.88	13.97	9.31	6.47
Fixed carbon, %	71.34	66.84	66.27	61.0	54.49
Calorific value, kcal/kg	5593	5738	6448	5366	4497

The above analyses indicate that the volatile matter in SLV coal is variable and goes as high as 13.97%. However, through systematic sampling, potential blocks can be identified and coal with less than 10% VM can be mined selectively to meet the requirement of VSK cement plants.

SICCO Fines

SICCO fines are produced in the Low Temperature Carbonisation (LTC) plant of Coal Chemical Complex, Mancherial, AP. These fines are categorised into three grades based on the size, viz, (a) coke +15 mm, (b) medium coke fines —15 to +2.5 mm, (c) small coke fines —2.5 mm. The analyses of SICCO fines whose availability is about 160 tpd are as in Table 3.

Borgua Coal

Low volatile coal is also available in Kalakot, Kura, Mahagola, Metka and Jangalgali collieries of M/s J&K Minerals Ltd, Srinagar which is locally referred to as 'Borgua coal'. The total reserves of this low volatile coal are estimated to be of the order of 3 million tonnes.

Leco Fines

Leco fines are produced by the low temperature carbonisation process of lignite and non-caking coals. The leco fines estimated at 5 LTPA available at Neyveli Lignite Corporation are categorised into carbonised sludge (—3 mm size) and super fine coke (—20 mm size). The proximate analyses of Borgua coal & Leco fines are as in Table 3.

Petroleum Coke

It is a carbonaceous material obtained as a refining residue by destructive heating of high molecular weight petroleum. Whilst the production of petroleum coke is 2.7 LTPA, the demand is reported to be about 2.5 LTPA, mainly from carbide industries and calciner units. Due to high cost and limited availability, the use of petroleum coke in VSK plants may not be feasible despite its high calorific value and low ash content.

TABLE 3

ANALYSIS OF OTHER ALTERNATE FUELS

Particulars	Air dried basis		Proximate Analysis	
	Medium coke fines	*Small coke fines*	*Borgua Coal*	*Leco Fines*
Moisture, %	3-6	3-6	0.64	5-8
Ash, %	34-38	34-40	43.87	10-30
Volatile matter, %	6-10	6-10	13.90	3-12
Fixed carbon, %	50-56	50-56	41.59	60-75
Calorific value, kcal/kg	4000-4500	4000-4500	4412	>5000

PLANT TRIALS

After establishing the prima-facie suitability through laboratory scale studies, plant trials on commercial scale using SLV coal, SICCO fines and Borgua coal were conducted. The findings are highlighted below.

SLV Coal

During trials, two separate raw mixes were designed one with SLV coal and the other with coke breeze; the proximate analyses of fuels used were as follows:

	SLV Coal	**Coke Breeze**
Volatile matter, % :	7.25	5.8
Ash, % :	28.87	29.98
Moisture, % :	5.0	4.0
Calorific value, kcal/kg :	4835	5200

A comparison of the average physical characteristics of cement produced using SLV coal as well as coke breeze indicated an over all

improvement, though marginal, in the case of cement produced using SLV coal. SLV coal being softer than coke breeze, the raw meal prepared using SLV coal gets into finer particle range as compared to the raw meal prepared using coke breeze. Hence the black raw meal prepared with SLV coal will have higher and uniform burning characteristics, as evident from the reduction in the Le Chatelier expansion of clinker from 4.8 mm to 4.3 mm. The clinker thus formed is expected to be more porous as compared to that produced with coke breeze, a fact substantiated by the photo-micrograph of clinkers shown in Plate 1. It is observed that though the morphology and microstructural features of both these clinkers are almost similar, the clinker produced with SLV coal shows more pore spaces and small grains.

SICCO Fines

SICCO fines are reportedly being used at a 100 tpd CRI-MVSK cement plant for the last 2 years and no operational problems were reported by the plant. Three raw mixes using (i) 100% SICCO fines, (ii) SICCO fines and coke breeze in the ratio of 74: 26 and (iii) a mixture of SICCO fines and Leco fines in the ratio 81: 19 were tried.

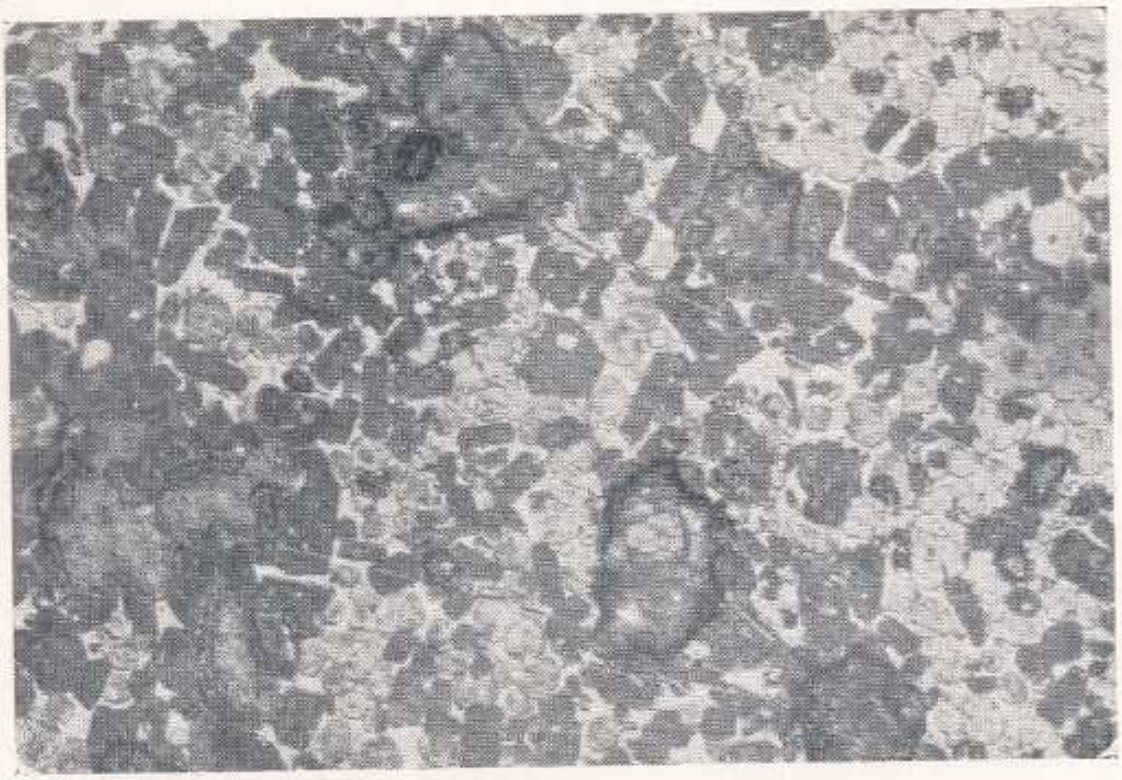
The data on litre weight and free lime in clinker during trials show that the coefficient of variation in the litre weight is of the order of 9.52×10^{-3}. Since there is not much variation in the quality of these fuels, the quality of the product was also more or less the same.

Borgua Coal

Another CRI-MVSK cement plant has been using Borgua coal for 2 years and producing cement conforming to IS : 269-1976 as in other cases. It was possible to obtain good quality clinker with high ash content of 44% in Borgua coal due to high grade limestone having CaO > 50%.

CONCLUSIONS

1) The burnability and micro structure studies of the clinker obtained using SLV coal as fuel indicate that the clinker phases are properly developed and free lime was well within the limits. Further no operational problems were experienced during the trials.



(i)

(ii)

Plate 1 Photomicrograph (× 280) of clinkers produced with (i) Coke Breeze (ii) SLV Coal

2) SLV coal is relatively cheaper, easily available and can directly be procured from Jharia coalfield of BCCL. SLV coal, therefore, be considered as most suitable alternate fuel for VSK plants. However, in view of the highly variable volatile matter (6 to 14%) in SLV coal, a strict quality control has to be ensured and the material should be procured only from those collieries/blocks which are reported to have the desired quality preferably after ascertaining the same.

3) The use of SLV coal may not be economical for the plants located in the southern part of the country in view of the long transportation distance. The plant trials with SICCO fines and Leco fines have indicated that these can suitably substitute coke breeze and can therefore be potential alternate fuels for such plants.

4) Borgua coal, though relatively high in ash content, has been found suitable for plants where high grade limestone and plastic clay are available.

5) Clinkers produced using SLV coal, SICCO fines, Leco fines and Borgua coal as tried at the plants resulted in cement conforming to the requirements of IS : 269-1976 (BIS-OPC-33 grade).

NCB TECHNOLOGICAL SUPPORT

NCB in association with Coal India Ltd and Bharat Coking Coal Ltd has identified potential SLV coal deposits which can substitute as fuel in VSK mini cement plants. Though the use of SLV coal, SICCO fines and Leco fines have been successfully established as alternate fuels, NCB shall provide the technical support as may be required by the VSK mini cement plants to overcome any operational and process problems in using these fuels.

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