National Council for Cement and Building Materials

UTILIZATION OF LIGNITE IN CEMENT INDUSTRY

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NCB TECHNOLOGY DIGEST

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INTRODUCTION

FUELWISE, cement industry in India is not so comfortably placed as in many other countries which happen to have an easy access to oil, gas or good quality coal. Barring a few exceptions, Indian cement plants are generally getting high ash coals with ash content ranging from 30 to 35 percent or even more. These high ash and low calorific value coals cause operational problems and affect the quality of clinker adversely. Beneficiation of coal could perhaps be an answer, but the conventional wet methods for upgrading the coal are yet to prove their economic viability. An alternative solution is envisaged by utilising lignite as a substitute fuel, specially in cement plants which are in the vicinity of such deposits.

RESERVES OF LIGNITE

In India, lignite deposits are found in Tamil Nadu, Gujarat, Kashmir, Kerala, Rajasthan, Shivaliks and pleistocene of the Himalayan regions. The total reserves are estimated at 2500 million tonnes, the major portion being in Neyveli in Tamil Nadu.

The texture, properties, colour and quality of the lignite vary from deposit to deposit.

CHARACTERISTICS OF LIGNITE

Lignite is the second stage in the coalification process and is placed between peat and ordinary bituminous coal. It has a brown colour and is amorphous in nature. Analysis of lignites from different deposits in India is given in Table 1. The moisture content of run-of-mine lignite from Neyveli in Tamil Nadu is of the order of 50-60% and ash content about 3-4%, with calorific value of about 2800 kcal/kg. But, due to atmospheric drying, moisture comes down to 40% and the calorific value correspondingly increases to 3400-4200 kcal/kg. On moisture-free basis the calorific value of lignite may range between 5000-6000 kcal/kg, with an ash content of 5-15%. Raw lignite is in the size range of 12·50 mm and below.

TABLE 1

ANALYSIS OF LIGNITES FROM DIFFERENT DEPOSITS IN INDIA

Deposit	Analysis on Air-Dried Basis, Percent				Analysis on Dry Mineral Matter Free Basis, Percent			Calorific Value (dmmf) kcal/kg	Ash Fusion Temp °C
	Moisture	Ash	Sulphur	Phosphorous	Volatile	Carbon	Hydrogen		
Tamil Nadu									
—Neyveli	10–30	5–10	0.5–2.0	0.011–0.020	52–60	70–73	4.6–5.5	6450–6600	1110–1260
Gujarat									
—Panandhro	15–35	7–20	3.6	—	50–60	68–72	5.1–5.6	6720–7000	—
—Umarsar	10–25	10–18	2.3	0.002–0.004	45–55	68–70	4.5–5.3	6500–7230	1100–1280
Rajasthan									
—Palana	25–37	4–8	2.4	0.004–0.020	45–58	72–75	4.5–5.5	6870–7000	1140–1340
Kashmir									
—Nichahom	10–25	40–45	0.5–0.9	—	60–65	65–69	4.5–6.8	5500–6500	1140–1350

The mineral matter is less in thick deposits, as in Neyveli and Palana. An analysis of the ash shows that it contains CaO, MgO and Na_2O as major constituents, the concentrations of which are more than that in bituminous coals. Minor constituents like vanadium, titanium (as TiO_2) and phosphorous pentoxide (P_2O_5) are present in Kashmir and Neyveli lignites. The mineral matters are kaolinite, gypsum, quartz and hydrated oxides of aluminium and iron. The presence of pyrites has also been established. Reactive groups present in the lignite are of hydroxy, carboxyl and carbonyl types. Sulphur is also present in some lignites (to the extent of 4%) in the form of sulphate, pyritic and organic sulphur.

PROBLEMS ENCOUNTERED IN USE OF WET LIGNITE

High moisture content in lignite leads to its sticking to the crushing and grinding units, choking and jamming of machinery and similar other undesirable phenomena. The output of the grinding mill may get reduced by about 20-25%. The kiln operation is also substantially affected because high moisture content in lignite increases the specific heat consumption and reduces the combustion efficiency. In addition, as lignite contains high volatile matter, it is more susceptible to catch fire. Sufficient care is thus required during drying, grinding, storage and handling of lignite.

LIGNITE AS A SUBSTITUTE FUEL

Because of its low ash content, lignite after drying, can be successfully used as a fuel in cement manufacture.

Partial substitution of coal with lignite may be advantageous, in which case, the lignite can be transported from the pithead to the cement plant, dried and then used as a mixed fuel along with bituminous coals. Lignite alone may not be used as a fuel because of its high volatile nature, SO_3 and alkali content. Also, the drying cost could be prohibitive.

By taking into account the volatile matter, calorific value and ash content of coal as well as of lignite, it has been estimated that partial substitution of coal by dried lignite (8-10% moisture content) to the extent of 30% (Fig. 1) may be possible in some of the existing plants without any major modification to the existing firing system. Subject to the raw material quality permitting, and depending upon the process of cement manufacture, even higher percentage of lignite, that is up to 50%, can be used.

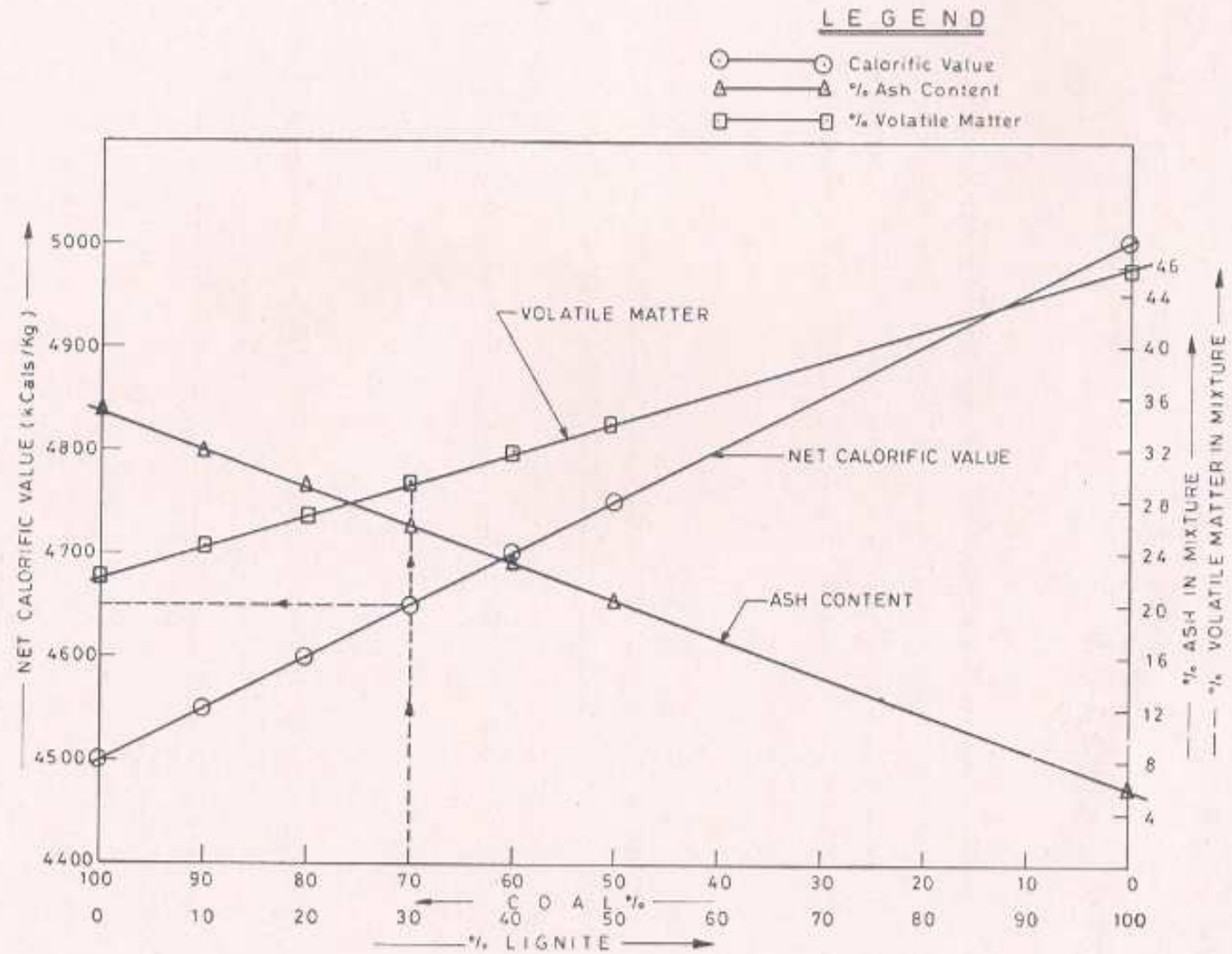

Fig 1 Relation between CV, Ash Content & Volatile Matter of Coal Lignite Mixture

SOURCES OF HEAT AND SYSTEMS FOR DRYING OF LIGNITE

As moisture in lignite leads to operational problems, its drying is essential. Studies were carried out in NCB on the drying characteristics of Neyveli and Gujarat lignites at different temperatures. An analysis of various systems applicable for drying of lignite has been made:

a) System based on recovery of heat radiated from the burning and transition zones of rotary kiln shell. The shell temperature is often as high as 300°C and the heat can be directly utilized for drying of the lignite by installing a shaking conveyor-dryer behind the kiln.

b) System employing dryers, such as tubular, tray, rotary/dispersion, vertical tray, fluidized/spouted bed, attritor-dryer-pulveriser, etc, with different heat sources available in the plant, viz, auxiliary furnace, waste heat from suspension preheater and grate cooler, etc.

c) System employing solar energy in conjunction with any of the above methods. Partial drying of lignite (from 30-35% to 18-20% moisture content) may be advantageously achieved by the use of solar energy.

TECHNO-ECONOMIC ANALYSIS

A broad techno-economic analysis of various systems for drying of lignite (for two 600 tpd wet process kilns) for its use as a substitute fuel

is given in Table 2 by way of illustration.

TABLE 2

TECHNO-ECONOMIC ANALYSIS OF VARIOUS DRYING SYSTEMS

System	Approximate Capital Investment (as on March 1987) (Rs Lakhs)	Pay-Back Period (Months)
Shaking Conveyor-Dryer	6	2
Tray Dryer	12	5
Tubular Dryer	20	8
Attritor-Dryer-Pulveriser	57	30
Rotary Dryer	68	36

However, the techno-economics may vary from plant to plant and will have to be worked out in each specific case.

CONCLUSIONS

The use of lignite in cement industry will help in effective utilisation of low grade coals in the country through partial substitution. The transportation problems faced by the coal industry will also be partially solved. Also, there will be an overall improvement in the operational efficiency of kilns.

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